Service Manual

Farmall A, AV, B, BN,

& International A Tractors

and

U-2 Power Unit

INTERNATIONAL HARVESTER
AGRICULTURAL EQUIPMENT DIVISION
401 NORTH MICHIGAN AVENUE • CHICAGO, ILLINOIS, 60611, U.S.A.

INDEX

INTRODUCTION AND BRIEF DESCRIPTIONS

Introduction ... 2
Brief Descriptions ... 2
Serial Number Identification ... 6

ENGINE

Description ... 7
Cylinder Head ... 7
Valves ... 9
Piston Assembly ... 9
Cylinder Sleeves ... 10
Connecting Rod and Bearings ... 10
Crankshaft and Bearings ... 11
Camshaft ... 13
Timing Gears ... 13

IGNITION SYSTEM

Magneto ... 14
Spark Plugs ... 16

COOLING SYSTEM

Description ... 17
Radiator ... 17
Fan ... 17
Heat Indicator ... 18
Radiator Shutter ... 18

ENGINE LUBRICATION SYSTEM

Description ... 18
Oil Pump ... 19
Crankcase Breather ... 19

FUEL SYSTEM

Carburetor—Description ... 20
Carburetor—Service: Zenith ... 25
Carburetor—Service: Marvel Schebler ... 28
Air Cleaner ... 32
Manifold ... 32
Engine Governor ... 33

Service Charts

Service Charts ... Center of Book

ENGINE CLUTCH

Tractors ... 36
Power Units ... 36
No. 22 Harvester-Thresher Engine ... 37

TRANSMISSION AND DIFFERENTIAL

Transmission—Description ... 38
Differential—Description ... 39
Service ... 39
Setting Bevel Gears ... 40
Brakes ... 42

FINAL DRIVE AND REAR AXLE

Description ... 43
Removal of Differential Shaft ... 43
Removal of Axle Shaft ... 43

ELECTRICAL EQUIPMENT

Description ... 43
Generator ... 44
Lighting Switch ... 44
Failure of Generator Output ... 45
Starting Motor ... 46
Battery ... 47

CHASSIS

Frame ... 48
Front Axle ... 48
Steering Gear ... 49
Front Wheels ... 49
Rear Wheels ... 50
Care of Tires ... 51
Pneumatic Tires ... 51
Liquid Weight ... 52

ATTACHMENTS

U-2 Power Unit ... 52
Tractors ... 53
Belt Pulley and Power Take-Off ... 54

DIMENSIONAL DRAWINGS

Farmall-A Tractor ... 56 to 58
International-A Tractor ... 58
Farmall-AV Tractor ... 59 and 60
Farmall-B Tractor ... 61 and 62
Farmall-BN Tractor ... 63
U-2 Power Unit ... 64

This manual has been prepared exclusively for use by International Harvester dealers.

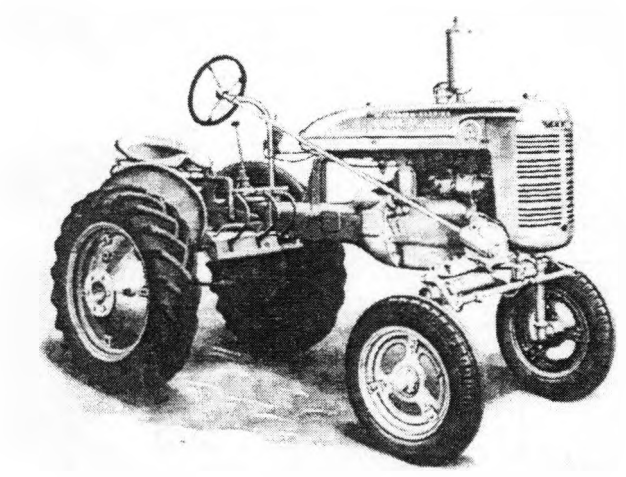
INTRODUCTION

This Manual covers five small tractors, Farmalls A, AV, B and BN and the International A industrial tractor, and one power unit, the U-2. These tractors have the same basic design, and with the U-2 power unit, they have the same dependable 4-cylinder engine.

The Farmall-A was the first of this series of tractors to be put on the market. The development of the AV, B, and BN tractors followed to meet the demand for this popular size tractor for use in crops and farming operations requiring different clearance or wheel arrangement and spacing than the original Farmall-A.

In the following paragraphs is given a brief description of each model with its principal uses. All tractors and power unit discussed in this manual are manufactured at Tractor Works.

BRIEF DESCRIPTIONS



Illust. 1. The Farmall-A equipped with adjustable front axle.

Farmall-A Tractor

The Farmall-A is of the four-wheel type. The rear wheel tread is adjustable by 4-inch intervals from 40 inches to 68 inches. The regular front axle has a fixed tread of 43 inches. An adjustable tread front axle is available which can be set to give front wheel treads from 44 to 64 inches.

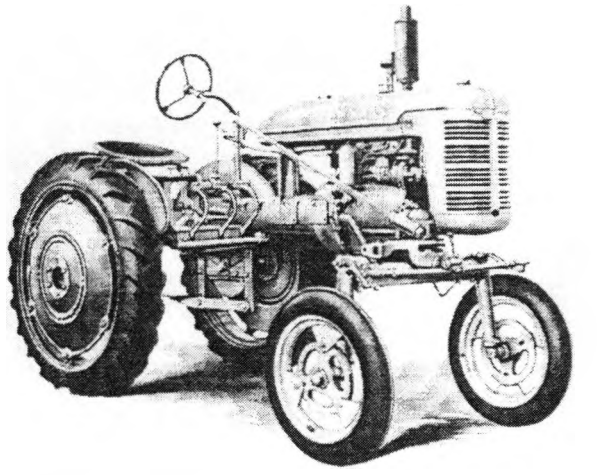
The engine, transmission and operator's seat are offset from the center of the axles, allowing an unusual area of vision. This unobstructed view is especially important in the cultivation of row crops. This feature, known as Culti-Vision, makes it possible for the operator to set the inside shovels as close to the rows as it is safe to go without danger of cutting the plant roots. A clean thorough job of cultivation can be done at speeds from 1½ up to nearly 5 miles per hour.

The Farmall-A cultivates one row of corn, cotton or similarly spaced crops or up to 6 rows in narrow spaced crops. It will plow 5 to 7 acres a day. Its ten-mile high speed adapts the Farmall-A to farm and highway hauling. On the larger farms the Farmall-A is a valuable addition to the larger tractors because of its economy in such operations as planting, cultivating and haying. The Farmall-A has four speeds forward and one reverse. Traveling speeds vary according to tire sizes. With 8-24 tires, at rated full load governed engine speeds, the forward speeds are 1.1, 3.4, 4.5, and 9.3 m.p.h.; the reverse is 2.7 m.p.h.

Farmall-AV Tractor

The Farmall-AV is a high-clearance 4-wheel tractor designed for work in crops planted on high beds. It is especially adapted to crops such as asparagus and

BRIEF DESCRIPTIONS

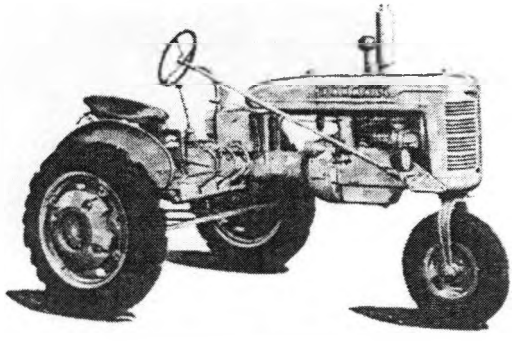


Illust. 2. The Farmall-AV high clearance tractor.

sugar cane, in which cultivation is continued until the plants have reached considerable height. The AV follows the basic design of the Farmall-A, principal modification being 5½ extra inches of crop clearance, adjustable tread front axle, and slightly higher field and road speeds as a result of the larger diameter of the rear wheels.

Farmalls B and BN Tractors

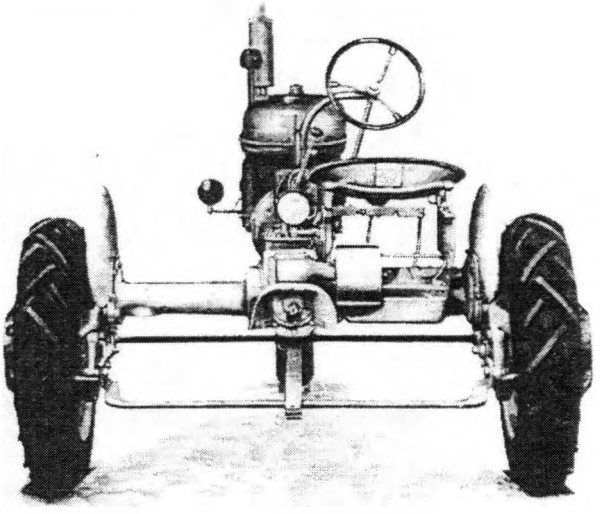
The Farmalls B and BN are three-wheel type tractors. The Farmall-B rear wheel tread is adjustable from 64 to 92 inches by 4-inch intervals. The Farmall-B rear wheel tread adapts it for two-row cultivation at row spacings of from 32 to 46 inches, such as cotton, corn and other crops of wide row spacings. Both Farmalls B and BN are adaptable for cultivation of up to 6 rows of the narrow spaced row crops. The Farmall-BN has a narrow rear wheel tread adjustable by 4-inch intervals from 56 to 84 inches. This narrow tread Farmall is adaptable for two-row cultivation of a variety of crops in row spacings from 28 to 42 inches, especially 28-inch row-spaced beans and other vegetable crops. Potato growers also find the Farmall-BN well suited to their requirements.



Illust. 3. The Farmall-B with electric lights and rear wheel weights.

The Farmalls B and BN are also Culti-Vision tractors, in which the operator has full view of the cultivating operation on the right side of the tractor where the operator's seat and platform are located. Row-crop cultivation may be accomplished at speeds of 1½ to nearly 5 miles per hour. Like the Farmall-A they will operate on approximately one gallon of fuel per hour, depending upon the nature of the work.

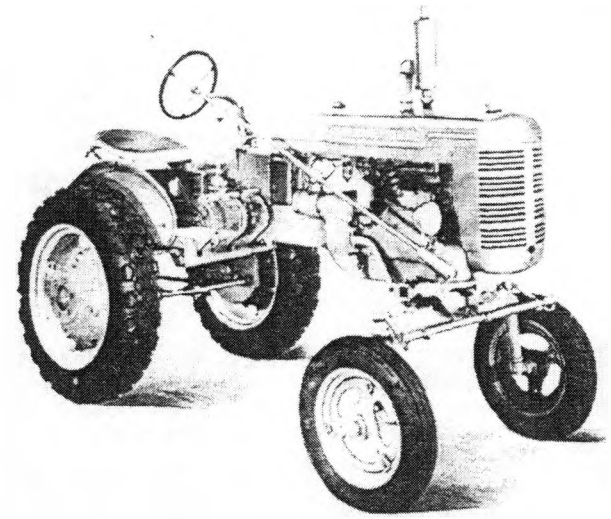
The use of these tractors is not restricted to the small row crop farm. Many are used as auxiliary tractors on the larger farms because of their wide range of utility made possible by the number of machines built to hitch directly to them, their ease of handling in the field and their economical power for haying, power take-off, belt work, and many other of the lighter jobs. Tractor traveling speeds are the same as on the Farmall-A.



Illust. 4. Rear view of the Farmall-B equipped with electric lights, belt pulley, power take-off, swinging drawbar and wheel weights.

International A Tractor

The International A industrial tractor is a 4-wheel tractor. The rear wheel tread is adjustable from 40 to 68 inches by 4-inch intervals. The front axle tread is adjustable from 44 to 64 inches by 4-inch intervals. This small tractor of the industrial line is similar to the Farmall-A with the exception of the front axle which is a heavy duty adjustable tread type. Speeds and axle clearances are the same as the Farmall-A.



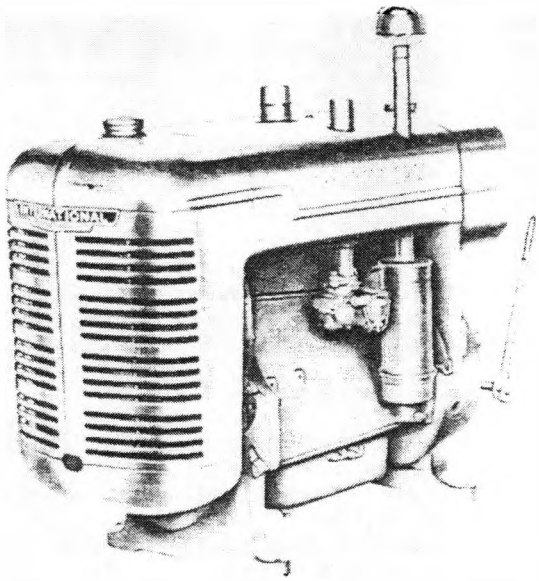
Illust. 5. International A equipped with electric starter and lights.

The economical operation and ease of handling makes the International A an ideal tractor for light hauling jobs, highway mowing, sidewalk snow plowing, sweeping, and many other jobs within its power range.

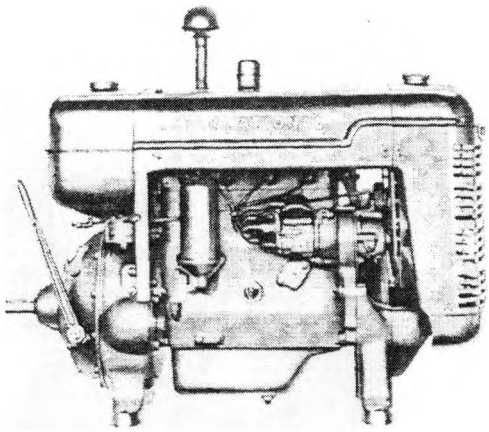
Tractor traveling speeds are the same as the Farmall-A.

U-2 Power Unit

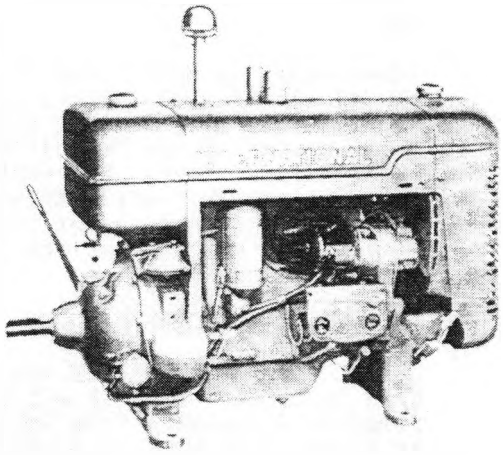
The Model U-2 power unit has the same basic engine as used in the A and B series tractors. This makes a compact, economical power unit which develops 22 net h.p. when operating on gasoline at



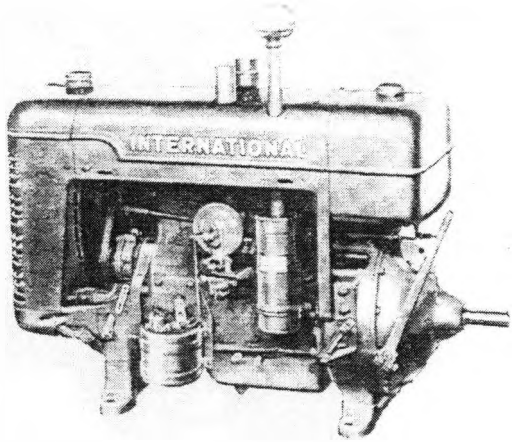
Illust. 6. International Model U-2 equipped as a complete, closed-type, independent portable power unit.



Illust. 7. Right side view U-2 power unit.

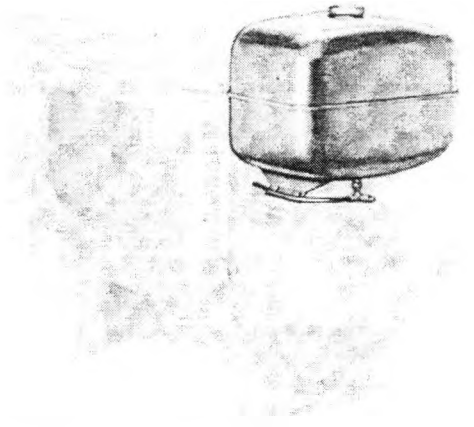


Illust. 8. The U-2 power unit with combination gas and gasoline fuel equipment, instrument panel, and automatic safety shut-off.

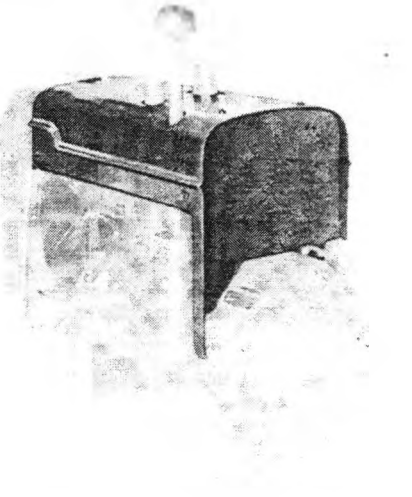


Illust. 9. Left side of U-2 power unit with combination gas and gasoline carburetor.

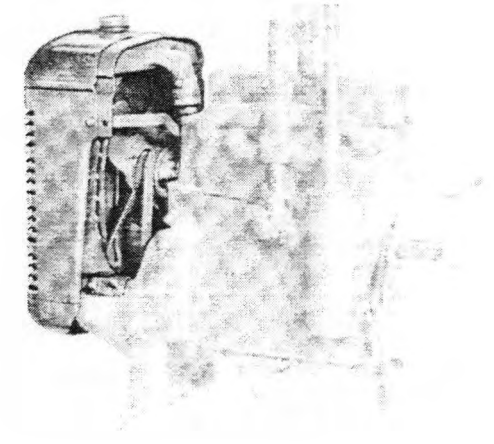
BRIEF DESCRIPTIONS



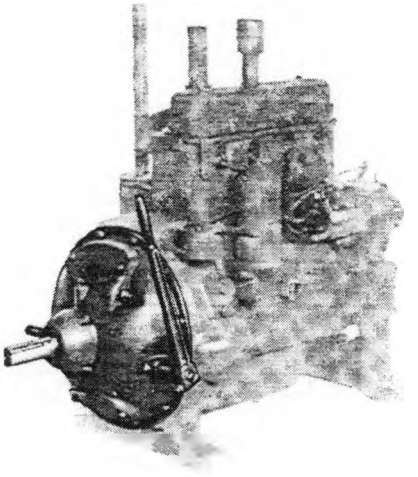
Illust. 10. View of fuel tank on complete U-2 unit.



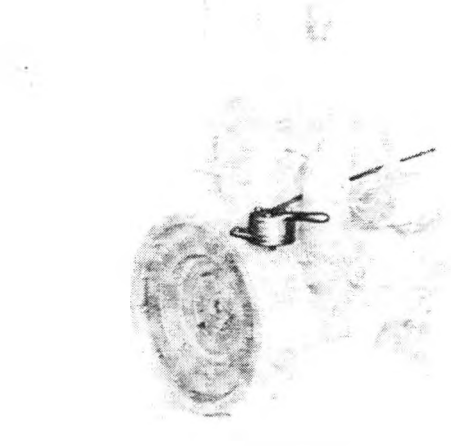
Illust. 13. The engine hood and rear hood sheet are a separate unit.



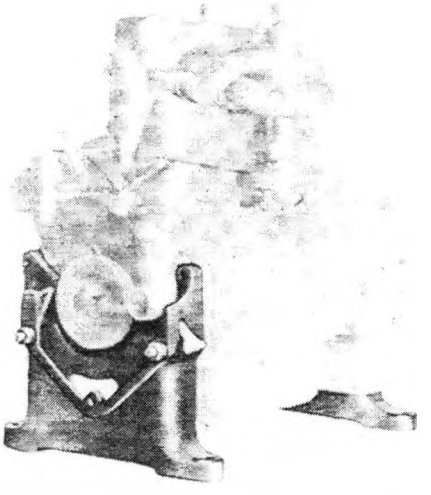
Illust. 11. Open type U-2 showing radiator.



Illust. 14. Open type U-2 showing power take-off.



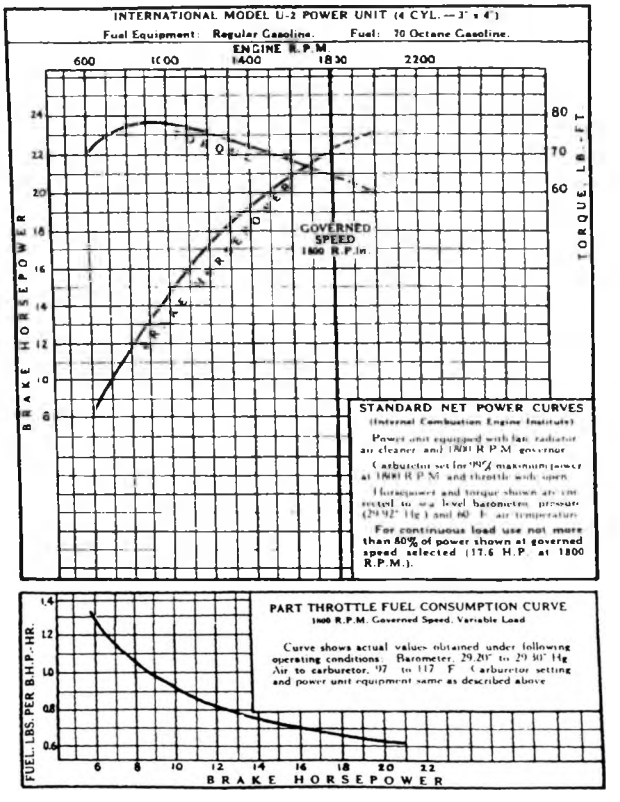
Illust. 12. Open type U-2 showing engine speed control.



Illust. 15. Open type U-2 with heavy-duty base which provides a firm foundation and low center of gravity.

regular governed speed of 1800 r.p.m. Equipment for operation on natural gas, distillate or kerosene is also available.

The governor is of the hand lever adjusted, variable speed, fly ball type, and has full control of the throttle at any engine speed from 1000 to 1800 r.p.m.


INTERNATIONAL MODEL U-2 POWER UNIT (4 CYL. — 3" x 4")
Fuel Equipment: Regular Gasoline. Fuel: 70 Octane Gasoline.
ENGINE R.P.M.
600
1000
1400
1800
2200
BRAKE HORSEPOWER
TORQUE, LB.-FT.
GOVERNED SPEED 1800 R.P.m
STANDARD NET POWER CURVES
(Internal Combustion Engine Institute)
For continuous load use not more than 80% of power shown at governed speed selected (17.6 H.P. at 1800 R.P.M.).
PART THROTTLE FUEL CONSUMPTION CURVE
1800 R.P.M. Governed Speed. Variable Load
Curve shows actual values obtained under following operating conditions. Barometer 29.20" to 29.40" Hg. Air to carburetor, 97° to 117° F. Carburetor setting and power unit equipment same as described above.
FUEL, LBS. PER B.H.P.-HR.
BRAKE HORSEPOWER

Illust. 16. Performance curves of U-2 power unit operating on gasoline.

Governor springs giving close regulation at 1200 r.p.m. as required for electric generator service are also available. The U-2 power unit can be furnished as a complete, self-contained power unit or less certain equipment such as radiator, engine hood, fuel tank, power take-off with clutch, or foot type base for any type of operation. The unit is equipped with a standard flywheel housing, SAE #4.

Serial Number Identification

SERIAL NUMBERS

Machine	Chassis Serial Numbers	Engine Serial Numbers
A	FAA-501 & up	Same as chassis
AV	FAAV-48562 & up	Same as chassis
B	FAB-3675 & up	Same as chassis
BN	FAB-39715-X7 to FAB-48349-X7; FABN-48459 & up	Same as chassis
Int. A	IAA-57284 & up	Same as chassis
U-2	UAA-501 & up	UAA-501 to UAA-7831; UAAM-7832 & up

* Suffix HA-5 and HA-8 denotes engine is equipped with 5000 or 8000-ft. altitude pistons.

ENGINE

Description

The A and B series tractors and U-2 power unit are powered with a 4-cylinder, 3 x 4 inch valve-in-head engine having a piston displacement of 113 cubic inches per revolution. Engines for the tractors are regularly equipped to burn gasoline, but may be secured equipped to burn distillate or kerosene. The U-2 power unit can be equipped to use the same fuels as the tractors and in addition can be equipped to burn natural gas.

Advanced engineering design in the shape of the cylinder head combustion chambers produces a high thermal efficiency and smooth operation of this engine, resulting in low fuel consumption and increased engine life. Other outstanding features of engine design are removable wet-type cylinder sleeves, replaceable precision connecting rod and crankshaft bearings, and force-feed lubrication.

The crankcase is ventilated to hold condensation of moisture to a minimum. Dust and abrasives are filtered out by the use of oiled wire gauze in the ventilator intake cap. An efficient centrifugal type governor maintains selected engine speed within reasonably constant limits under varying load conditions. The governor is simple in design with a rock shaft mounted in nonfriction bearings to ensure the snappy governor action so desirable for belt or drawbar work.

Efficient filters are provided to prevent dirt and abrasives from entering the engine through the carburetor air intake or in the lubricating oil. Proper servicing of these filters, as outlined in the Owner's Manuals, will add many hours of useful engine life.

The engine is equipped with an International Harvester H-4 waterproof high tension magneto having automatic impulse coupling which insures easy starting and hot sparks for all engine speeds. The magneto is flange mounted as another precaution in sealing the engine against entry of dirt.

Cylinder Head

The same type cylinder head is used on all engines. Changes in compression ratio necessary to properly burn the various fuels and to meet conditions of various altitudes is accomplished by using longer or shorter pistons.

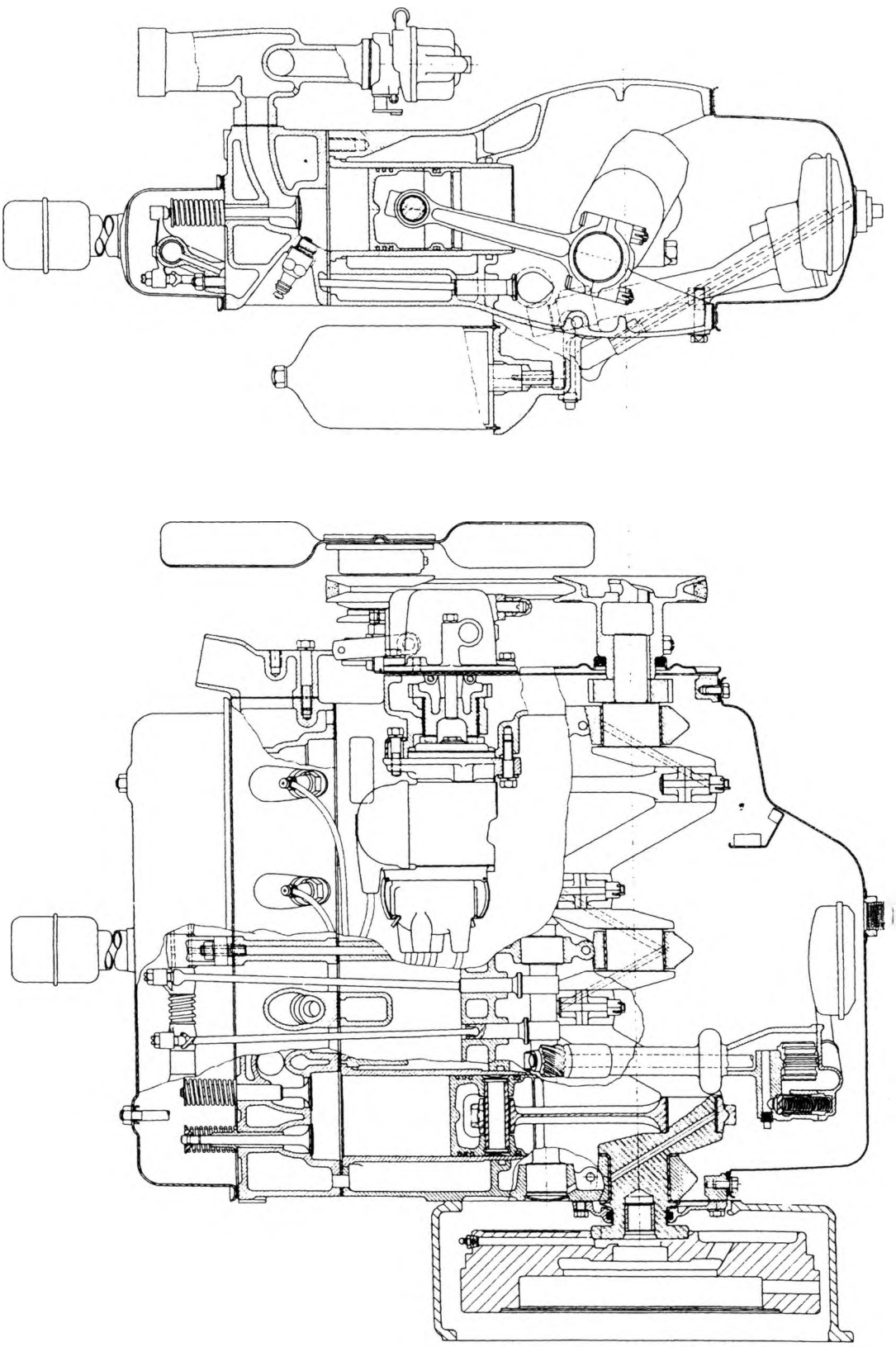
SPECIFICATIONS

Stud diameter, in.	1/2
Nut tension, ft.lb.	65
Valve guides, replaceable:	Service guides reamed to size.
Valve seat angle, degrees	45
Seat width, in.	5/64
Valve port diameter, in.:	
Intake	1-3/16
Exhaust	1-1/16
Valve seat insert rings:	Cannot be installed.

Valve guides are replaceable. The service guides are reamed to give 0.0015 to 0.0035-inch clearance between valve stem and guide. Broken, burned, cracked, or worn valve guides should be replaced, taking care not to damage the top edge of the bore in the guide when pressing them into the cylinder head. A true valve seat cannot be obtained when excessive clearance exists between valve stems and worn guides.

Valve seats in the head are at an angle of 45 degrees and should be approximately 5/64-inch wide for both intake and exhaust. They should contact the approximate center of the valve face. Before refacing the valve seats the valve guides should be carefully inspected to avoid removing any more seat material than necessary to secure a good seat; they should be replaced if necessary.

When replacing the cylinder head, the use of a new head gasket is good insurance against leakage and the added labor involved in making the change if leaks occur. The proper use of a good torque wrench eliminates the possibility of distorting cylinder sleeves and valve seats, which may occur when a cylinder



Illust. 17. Sectional views of engine.

head is tightened down unevenly. The sequence of nut tightening begins at the center of the head and works back and forth across the head toward each end.

Valves

SPECIFICATIONS

Head diameter, in:	
Intake	1-11/32
Exhaust	1-7/32
Material:	
Intake	MD 3140
Exhaust	Silichrome XCR
Stem diameter, in.	.3405 to .3415
Stem clearance in guide, in.	.0015 to .0035
Length overall, in.	4-53/64
Seat angle, degrees	45
Valve lever clearance (warm), in.	.014
Valve spring test:	
Free length, in.	2-5/8
Test	43 lb. at 1-43/64 in.
Valve timing (allowable variation ±5):	
Intake: Opens 15° after TDC; closes 35° after TDC.	
Exhaust: Opens 42° before BDC; closes 10° after TDC.	
Valve lift, in.	.261
Valve lever shaft diameter, in.	.748 to .749
Lever bushing clearance on lever shaft, in.	.002 to .004

Clean and inspect valves before refacing. Valves having excessive stem wear, bent stem, burned or warped head, or head ground down to a thin edge should be discarded. Those found fit for re-use may be refaced and the end of the stem squared. Most valve refacing machines have a fixture for this purpose. A valve having a grooved or worn end on the stem tends to crowd one side of the valve stem guide and also makes it impossible to secure accurate valve lever adjustment.

Valve springs are the same for intake and exhaust on all the engines of this series. Springs showing rust pits, that are cocked or lack proper tension should be replaced. When removing or replacing the valve spring collar keys avoid distorting the spring by compressing it any further than absolutely necessary.

Valve levers are lubricated by pressure. A slot in the center bearing surface of the camshaft allows an intermittent flow of oil to pass up to the hollow valve lever shaft. Bushings in the valve levers are replaceable and must be reamed after being pressed in to give a shaft clearance of 0.002 to 0.004 inches.

When wear occurs where the valve lever contacts the valve stem contact it may be refaced if not worn through the hardened surface. Most valve refacing machines are equipped with an attachment for refacing the valve levers. It is important that the face of the valve lever is in good condition. A worn face may place a side thrust on the valve stem and also make it impossible to obtain an accurate valve lever adjustment. The clearance between the valve lever and valve stem should be adjusted to 0.014 inches with the engine at operating temperatures. This may be accomplished with the engine running at a slow idle or when the piston for each cylinder is at top dead center of the compression stroke.

Piston Assembly

SPECIFICATIONS

Piston material	Gray iron
Piston length, in.	3-1/2
Clearance in sleeve: .003 to .004 in. A .0025-in. ribbon gauge, 1/2-in. wide, may be used as a "go" gauge with a light pull of 4 to 6 lb. tension. A .0035-in. gauge may be used as a "no go" gauge with a tight pull of 11 to 14 lb.	
Compression rings (.124-in. wide): 3 per piston.	
Oil control ring, located below piston pin: (.249-in. wide); 1 per piston.	
Ring gap, in.	.010 to .018
Ring clearance in groove:	
Top compression, in.	.004
Others, in.	.003
Piston pin (full floating) diameter, in.	.9192 to .9195
Piston pin length, in.	2.497 to 2.508
Pin clearance in piston, in.	.0005
Pin clearance in connecting rod, in.	.0007
Piston pin retainers: Snap ring at each end of pin.	

Pistons are not available as individual units, but are furnished as matched sets with sleeves. Each piston and sleeve set is selected to give a clearance within the limits shown in the specifications. For service, fitted sleeve and piston assemblies are available singly or in matched sets of four.

In the regular production rings, the third compression ring from the top of piston has a tapered face and must be assembled with the stamped word "TOP" toward the top of the piston. The oil control ring is assembled in the bottom groove.

In addition to the regular production rings there are available replacement

piston ring kits which will compensate for a certain amount of piston and cylinder sleeve wear. If the sleeves are not worn more than 0.012-inch taper from top to bottom of ring travel or are not more than 0.003-inch our of round (egg shaped), and the piston ring grooves are not worn to give more than 0.006-inch ring clearance, additional useful life of these sleeves and pistons may be had by installing the replacement ring kit.

The ridge left at the top of the ring travel in the sleeve must be removed with a ridge reamer to prevent damage to the piston or the new top compression ring. Arrange the piston rings by sets for each piston before checking ring gap in bore. To measure the ring gap, a piston should be used to push the ring into the bore so that the ring will be square with the cylinder wall. Then, with the ring at the point of smallest diameter of the ring travel in the bore, use a feeler to check the gap between the ends of the ring.

Before mounting the rings on the piston, thoroughly clean all carbon from ring grooves and open all drainage holes in the oil control ring groove and check the piston and connecting rod alignment (see page 11). Mount the rings in the proper grooves, being sure they are free, and stagger the ring gaps around the piston. Lightly coat the rings, piston and cylinder wall with engine oil before slipping the piston into the cylinder.

Pistonspins are of full-floating type, secured in the piston by snap rings. The piston pins are a hand press fit. An oversize piston pin (.005-in.) is available. The piston bore and connecting rod bushing should be reamed or honed to give clearances listed in the specifications. After installing new piston pins the connecting rods should be checked for proper alignment (see page 11).

Cylinder Sleeves

SPECIFICATIONS

Type	Wet
Bore, in.	3
Overall length, in.	6-7/8
Wall thickness, in.	15/64
Water jacket length, in.	4-7/8
Seal at top	Head gasket
Seal at bottom	Rubber ring

The replaceable, wet-type cylinder sleeves used in all A, B and U-2 engines are selectively fitted to the pistons to give the normal measured clearances as listed in the piston specifications.

CAUTION: When installing a new set of sleeves and pistons, do not interchange the pistons in the cylinder sleeves or the piston pins among the pistons. After the new pistons are mounted on the connecting rods the alignment of the rods should be checked (see page 11).

Special pullers are available for removing cylinder sleeves from the crankcase. Before installing new sleeves in the crankcase the counterbore at the top, and the seal ring groove at the bottom of the crankcase should be thoroughly cleaned.

Be sure the sleeves fit free in the crankcase before the seal rings are installed. The seal rings are placed in the crankcase grooves dry; the tapered outer surface of the cylinder sleeves are coated with a soap solution about the consistency of jelly. This soap solution acts as a lubricant for entering the sleeve into the rubber seal ring and does not harm the rubber ring. Lower the sleeve into position making sure the rubber seal ring is in place. Push the sleeve home. If the rubber seal ring is in place and not pinched, very little hand pressure is required to push the sleeve completely into place.

Connecting Rods and Bearings

SPECIFICATIONS

Type	Heat treated forged I Beam
Distance between bearing and bushing centers, in.	7-1/4
Connecting rod bearing (replaceable precision type):	
Material	Steel-backed babbitt
Length, in.	1.187
Diameter, in.	1.749 to 1.750
Side clearance, in.	0.003 to 0.013
Diameter running clearance, in.	0.0015 to 0.003
Piston pin bushing (replaceable):	
Material	Bronze
Length, in.	1.218
Bore, in.	.9196 to .9199
Diameter running clearance, in.	.0007
Number of bolts per rod	2
Bolt size, in.	3/8
Bearing bolt, nut tension, ft. lb.	40

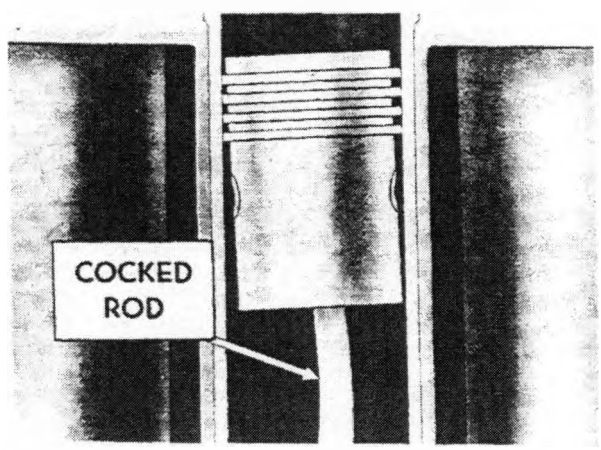
Connecting rods are stamped with the cylinder number on both cap and rod, number one starting at the front, or timing gear end of the engine. The numbered sides of rod and cap are installed facing toward the camshaft side of engine. Connecting rod bearing running clearance

may be checked by placing a .003-inch brass shim (1/4 x 1-in. long) lengthwise between lower bearing and crankshaft. If the clearance is not excessive, there should be a slight drag when turning the crankshaft with the spark plugs removed.

Bearings are not adjustable; when clearance is excessive, they should be replaced. Under no conditions should the rod or caps be filed to tighten bearings; such a procedure would make the rod unfit for use with new bearings. Connecting rod bearings are available in .003-inch undersize for use on crankshafts with a slight amount of wear; for the reground "exchange" crankshafts the .030-inch undersize bearings are used.

When installing bearings be sure bearing backs and rod surfaces are absolutely clean, smooth and free from oil. Bearings have a nib or projection which prevents turning and must be assembled with the nib engaging the milled notch in the rod and cap. Be sure oil passages in the crankshaft are clean. A rifle barrel brush and air blow gun are useful in thoroughly cleaning such passages. Piston and rod assemblies are removable through the top of the cylinder bore. It is not necessary to remove the engine from the tractor to perform this operation.

Proper alignment of the connecting rod bearing in relation to the piston pin and piston skirt is most important. Cocked or twisted rods will prevent piston and rings from contacting the cylinder walls squarely (Illust. 18), which will result in oil being pumped up past the rings. Where rods are badly cocked, a knock may develop caused by the rod striking the piston boss. This indicates the rod is offset toward front or rear.



Illust. 18. Bent connecting rods prevent rings from making proper contact with cylinder walls.

Many cases of excessive oil consumption have developed after new rings, pins or new piston and sleeve assemblies have been installed, because of neglect to check and correct the alignment of the connecting rods.

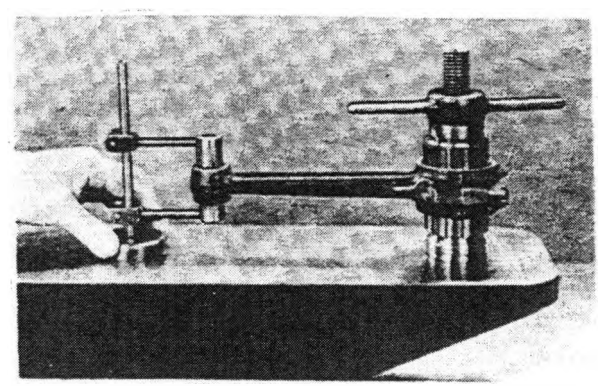
Misalignment of connecting rods may be caused by engine overloads, detonation or, in the replacement of piston pins, where bushings may be reamed out of parallel with rod bearing. Illustration 19 shows a fixture for checking connecting rod alignment.

Crankshaft and Bearings

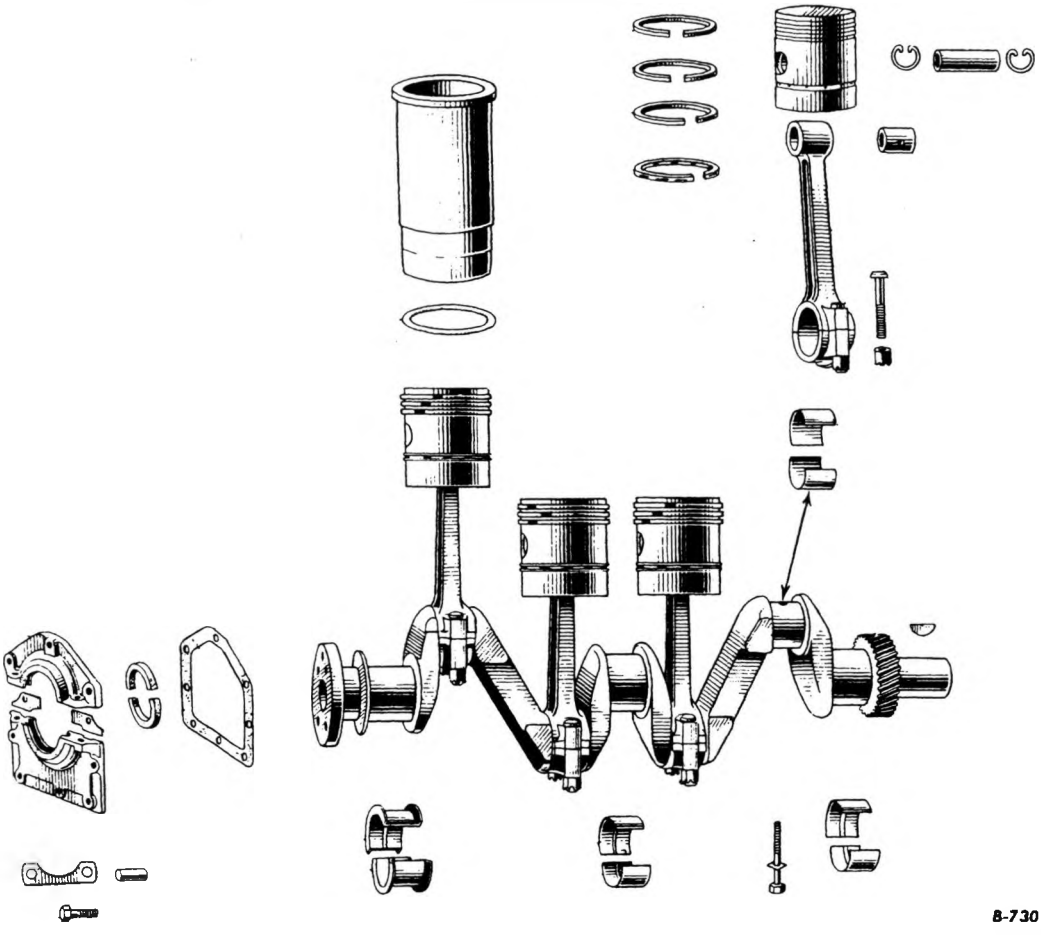
SPECIFICATIONS

Crankshaft:	
Material (SAE forging steel):	1045 with 0.3% chrome.
Overall length, in.	22-19/32
Weight, lb.	27
Bearing surfaces	Tocco hardened.
Bearings:	
Number	3
Type:	Precision, steel-backed babbit
Diameter, in.	2.125
Length:	
Front bearing, in.	1.370
Center bearing, in.	1.370
Rear bearing, in.	1.839
Running clearance, in.	.0015 to .003
Crankshaft end clearance (end thrust taken on rear bearing), in.:	.004 to .008.
Bearing cap bolt, in.	1/2
Bearing bolt tension, ft. lb.	75

Crankshafts have Tocco-hardened bearing journals and are drilled for pressure lubrication of connecting rod bearings. Each main bearing cap is numbered to correspond with a number stamped on the camshaft side of the crankcase. The precision type bearings are not adjustable; when running clearances become excessive, replacement is necessary. Clearance may be checked by placing a .003-



Illust. 19. Recommend fixture and method of checking connecting rod alignment.



Illust. 20. Exploded view of crankshaft, connecting rods, piston and cylinder sleeves.

inch brass shim (1/4 x 1-in. long) lengthwise between lower bearing and crankshaft. If there is a slight drag when turning the crankshaft with spark plugs removed the clearance is not excessive. Check end clearance with the feeler gauge at the front side of the rear bearing on both upper and lower thrust faces; be sure crankshaft is held against the rear thrust face of bearing to show total clearance at the front side.

In an emergency the crankshaft bearings may be replaced without removing the crankshaft from the case, but extreme care must be taken to insure the cleanliness of the bearing backs and crankcase bore. These surfaces must be absolutely clean and dry when installing bearings. Small particles of dirt between the bearing and crankcase bore will distort the bearing shell and reduce the running clearance at that point. The frictional heat produced results in bearing material being melted loose at that point. Such melted material often lodges between the bearing and shaft at other points of the bearing surface and creates other hot spots until complete bearing failure results. Anything which interferes with the heat dissipation of a bearing has its effect on bearing life.

To remove the upper half of a bearing with the crankshaft in place, insert in the crankshaft journal oil hole a cotter pin or its equivalent which has a rounded head flattened to form a "T" and then rotate the crankshaft to push out the bearing. The bearing cap and bore are milled to receive the projection on the back of bearing; the projection end of bearing is removed first. When replacing the bearing rotate the shaft so that the projection end enters last.

To remove the rear main bearing cap it is necessary to first remove the crankshaft rear oil seal retainer plate. On the U-2 power unit only, the flywheel must be removed before the oil seal retainer plate can be removed. Care must be taken not to harm the gasket between the oil seal retainer lower and the oil seal retainer plate, because replacement of this gasket calls for removal of the flywheel on all engines.

The replacing of crankshaft main bearings without removing the crankshaft should be done only in an emergency. When these bearings are worn sufficiently to require replacement or have failed through lack of lubrication the entire crankcase and its oil distribution bores should be thoroughly cleaned. This cannot be accomplished without the removal of the crankshaft. The crankshaft front and rear oil seals should also be replaced. This cleaning of the crankcase and replacing of oil seals is the best insurance against early bearing failure through dirt left in the crankcase or from dirt entering worn crankshaft oil seals.

Crankshaft bearings are available in standard size and 0.030-inch undersize. The undersize is for use with the reground "exchange" crankshaft. One defective main bearing will require replacement of all three bearings; otherwise crankshaft alignment cannot be maintained.

A good torque indicating wrench should be used when tightening main bearing cap bolts to insure even tension on all bolts and to prevent distortion of the crankcase. The bearing bolts are locked by bending the locking strip against the hex face of the bolt.

Oil seals are provided at the front and rear of the crankshaft. The front seal is leather, located in the crankcase front cover. The lip of the seal should face toward the inside of the engine. The seal is pressed into the front cover from the inside, making it necessary to remove the cover to replace seal. The rear oil seal is of split type felt. The flywheel must be removed to replace this seal. When oil leaks in front of the flywheel, check the fit of the expansion plug at the rear of the camshaft and check the rear crankshaft bearing for excessive wear.

Four 3/8-inch diameter bolts and two dowel pins are used to attach the flywheel to the crankshaft flange. Bolts are tightened to 37 ft. lb. torque and locked by metal lock strips.

The clutch pilot bushing is pressed into the rear of the crankshaft to a point 5/16-inch in from rear face of crankshaft. The inside diameter of the pilot bushing is .875 to .876-inch. The U-2 power unit only is equipped with a clutch pilot ball bearing which is mounted in the flywheel bore. Lubrication of this shielded ball bearing is accomplished through a grease fitting on the outside diameter of the flywheel. This may be reached for greasing through the opening in the left side of the flywheel housing.

Camshaft

SPECIFICATIONS

Material: SAE 1015 forging steel, wearing surfaces carburized and hardened	
Overall length, in.	19-5/32
Minimum diameter, in.	1
Diameter and length, in.:	
No. 1 bearing	1.811 x 1-3/8
No. 2 bearing	1.577 x 1
No. 3 bearing	1.499 x 1-3/16
Running clearance, in.	.001 to .003
Bearing material: Gray iron (bored in crankcase).	
End clearance, in.	.005 to .010
Type of drive	Helical gear
Timing gear tooth face width, in.	13/16

The camshaft is mounted in the crankcase without bushings, the bore in the gray iron case forming the three bearing surfaces. The end clearance is limited by a retaining thrust plate between the crankcase and drive gear. The rear bearing bore in the crankcase is sealed from oil leakage into the flywheel housing with an expansion plug.

The camshaft is removed by removing the two 3/8 x 3/4-inch cap screws from the camshaft retaining thrust plate. (These cap screws may be removed through openings in the drive gear.) The valve tappets must be raised to clear the largest diameter of shaft and the oil pump must be removed. This allows the camshaft to be removed from the front end of the crankcase. After the camshaft is removed, the valve tappets may be removed from their bores in the crankcase.

Timing Gears

With the governor housing and crankcase front cover removed, the timing gear train is accessible. These gears must be in their proper place to have the engine timed properly. A single center punch mark between the teeth on the crankshaft pinion should line up with a single punch mark on a tooth of the camshaft gear; and two punch marks on a tooth of the camshaft gear should line up with two punch marks between teeth on the magneto and governor pinion.

The crankshaft pinion and camshaft gear are press fit on their shafts, and

held in proper position by woodruff keys. The magneto and governor pinion together with the governor weights can be removed from the case bushing in which the complete mechanism revolves. This assembly is held back in place by a bumper spring and pin contacting the governor stop pin in the governor housing. When performing pressing operation on crankshaft pinion or camshaft gear be sure that no pressure is placed on ends of gear teeth because this may damage the teeth.

IGNITION SYSTEM

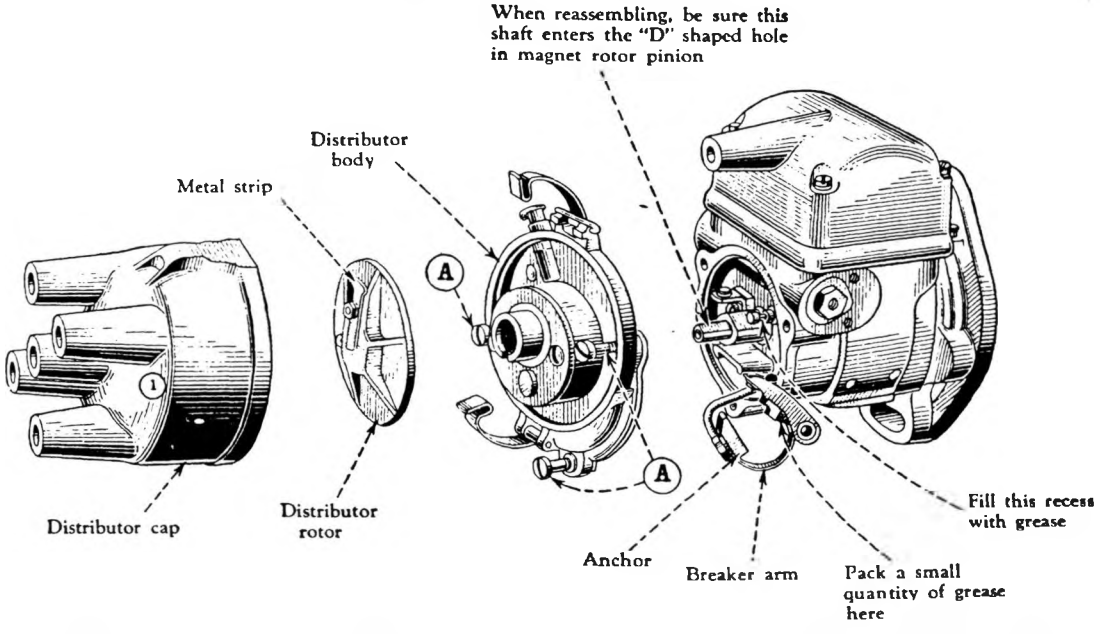
SPECIFICATIONS

Magneto, manufacturer and model	IH: H-4
Rotation	Clockwise
Breaker point gap, in.	.013
Impulse coupling trips	TDC
Spark advance, degrees	35
Magneto gear, helical, no. teeth	33
Drive gear	Camshaft
Spark plug, size	18 mm, 7/8 hex
Spark plug gap, in.	.028 - .032
Firing order	1-3-4-2

Magneto

The magneto used is an International Harvester Model H-4. It has a fixed spark, runs clockwise (facing drive end) and is flange mounted to the crankcase. It includes an impulse coupling for starting purposes, which retards the spark timing 35 degrees. The impulse coupling trips at top dead center of the piston travel. The magneto runs at the same speed as the engine crankshaft.

In greasing breaker mechanism and checking points it is important to keep the breaker arm chamber clean, because oil on the breaker points will cause arcing and rapid point wear. Overlubrication of the distributor bearing oil cup may cause a dirty breaker point chamber. If the chamber is clean, no further attention is necessary other than checking the clearance of the points; but if the chamber is dirty, all parts must be thoroughly cleaned. After cleaning, the points should be dressed, the point clearance checked, and the breaker arm regreased.



Illust. 21. Magneto parts that need to be removed to gain access to breaker points.

To reach the breaker mechanism, remove the distributor cap and crank the engine slowly until the metal strip on the distributor rotor points toward the No. 1 terminal on the distributor cap and the impulse coupling just trips. Remove the distributor rotor. Take off the distributor body by removing the three screws "A" (Illust. 21).

Pry the breaker arm and the spring anchor from the chamber and clean all parts. Inspect the breaker points and, if necessary, dress them with a sharp, fine file. If the points are worn excessively, replace both points.

Fill the recess in the breaker post with IH magneto grease and pack a small quantity of the grease in back of the breaker arm rubbing block (Illust. 21). Assemble the breaker arm, leaving the spring anchor projecting 1/8 to 3/16 inches out of its slot so it is pushed into place by the distributor body. Be sure the points line up after the breaker arm is pushed into place.

Check the gap between the breaker points, using a .013-inch feeler gauge, being sure the rubbing block is on the high point of the cam. If the gap is not correct, adjust by loosening the screw holding the adjustable point (Illust. 22) and moving the point up or down until the gauge slips snugly between points. After proper adjustment has been made, tighten the screw.

Line up the distributor rotor key with the keyway in the spindle (Illust. 21) and press the rotor loosely on the spindle. With the engine on top dead center of the No. 1 firing stroke, turn the distributor rotor until the metal strip on the rotor points to the No. 1 terminal on the distributor cap. Place the distributor body on the magneto and be sure the rotor shaft enters the "D" shaped hole in the distributor pinion. Remove the distributor rotor to tighten the three screws "A" (Illust. 21). Replace the distributor rotor and cap.

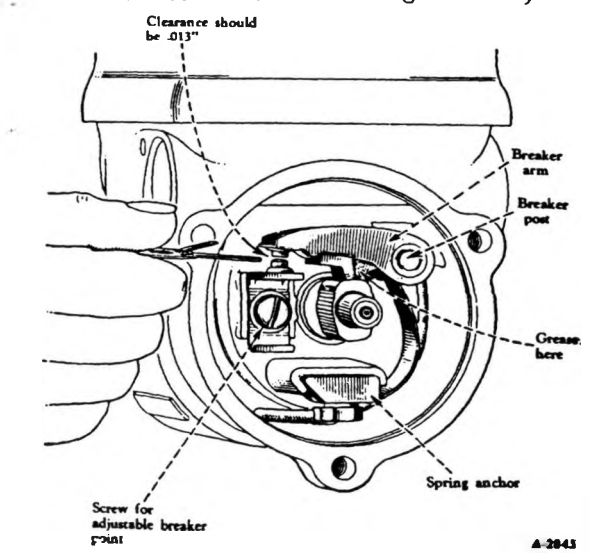
The distributor cap should be kept reasonably free of dust and oil deposits. The distributor rotor should also be kept clean. The two small ventilating holes "B" (Illust. 23) at the bottom of the distributor cap should be kept open at all times to help reduce condensation of moisture in the distributor.

Removal of the magneto is accomplished by disconnecting the switch wire from its terminal on the side of the magneto, disconnecting the spark plug cables and removing the two cap screws, washers and mounting clip which hold the magneto to the crankcase.

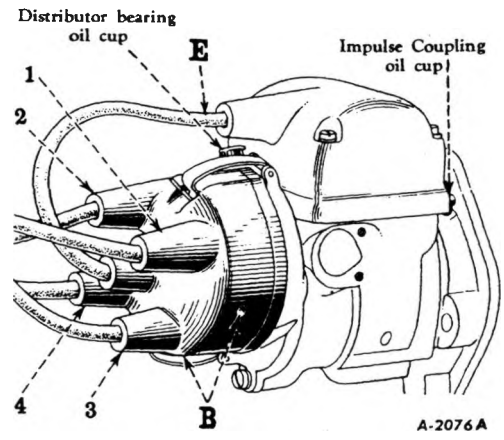
Installing and Timing Magneto to Engine

(1) Pull out the cable "E" (Illust. 23) from the coil cover end. This will eliminate any possibility of accidental starting.

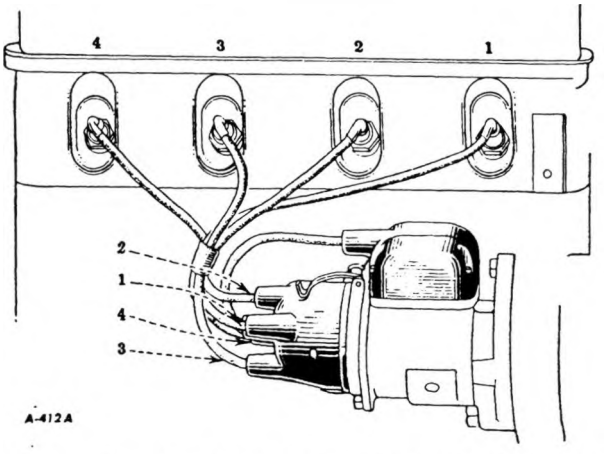
(2) Crank the engine until the No. 1 piston (the piston next to the radiator) is on the upper dead center of the compression stroke. The compression stroke can be determined by removing the No. 1 spark plug, placing the thumb over the opening, and cranking the engine until an outward pressure is felt. Continue cranking slowly until the D.C. No. 1 mark on the flywheel is in line with the timing pointer as seen from the opening in the bottom of the flywheel housing. On the U-2 power unit this is checked through



Illust. 22. Checking breaker point clearance with feeler gauge.



Illust. 23. Distributor end of magneto showing oil cups and vent holes "B".



Illust. 24. Ignition wiring chart, firing order of engine is 1, 3, 4, 2.

an opening in the left side of the flywheel housing. Both intake and exhaust valves would then be closed.

(3) Remove the distributor cap and turn the magneto coupling in a counter clockwise direction (as viewed from the coupling end) until the metal strip on the distributor rotor points toward the No. 1 terminal on the distributor cap. Replace the distributor cap.

(4) Assemble magneto on engine, making sure that lugs on the impulse coupling engage in slots on the magneto drive coupling. Assemble the magneto so that the top is as close to the crankcase as possible.

(5) Insert the magneto mounting bolts loosely in the magneto flange, just enough to hold magneto in place. Then crank the engine one complete revolution to the next top dead center. Now, pull the upper part of the magneto away from the engine until the impulse coupling just trips.

(6) Tighten the mounting bolts securely. Attach the spark plug cables to the engine and magneto (Illust. 24). Start by connecting the No. 1 cylinder spark plug to the socket marked "1" on the distributor block, connect the No. 3 socket with the No. 3 cylinder, next with No. 4 cylinder, next with No. 2 cylinder.

(7) Connect the switch cable to the magneto terminal.

(8) To check timing, crank the engine slowly until the top dead center of the No. 1 cylinder is reached, at which time the impulse coupling should just trip.

(9) The magneto is now correctly wired and timed.

(10) Push cable "E" back into the socket in the coil cover (Illust. 23).

For complete overhauling information on the H-4 magneto, see the Blue Ribbon Service Training Course Manual No. 1 (form No. CHS-27).

Spark Plugs

Spark plugs used in regular production are of a heat range selected for moderate or normal service. Should the engine be subjected to severe or extremely severe service, the burning of spark plug porcelains and/or electrodes may occur, resulting in pre-ignition from the overheated elements. Such an operation condition calls for the installation of colder (severe service) spark plugs. To remedy fouling or sooting as the result of light load service, use a hotter (light service) spark plug. (See spark plug charts issued from time to time.)

Sand blasting is the recommended method of cleaning spark plugs. Never scrape or clean the insulator with anything which will scratch the porcelain, as this would allow carbon to accumulate much faster.

Spark plug cables should clear the cylinder head by 1/4 inch to prevent damage to cables from heat and resultant shorting out of the spark plug. The magneto ends of the cables should be firmly seated in their sockets to prevent sparking within the sockets, which would result in damage and corrosion at the terminals.

COOLING SYSTEM

SPECIFICATIONS

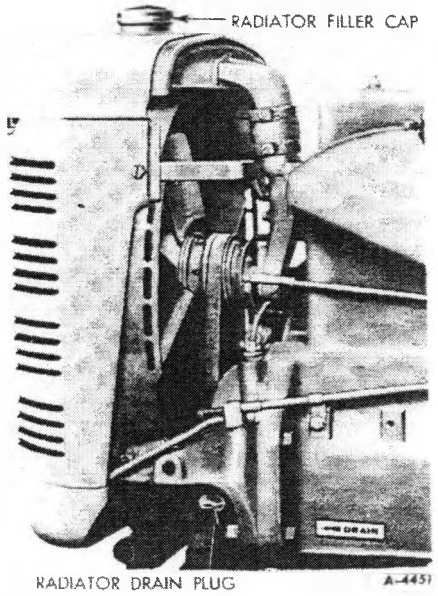
Type, circulation	Thermosiphon
Radiator type	IH flat tube
Fan drive type	V-belt to crankshaft
Fan diameter, in.	16
Fan blades, no.	4
Fan-to-engine ratio, rpm	1.52 to 1
Cooling system capacity, gals.	3-3/8
Radiator shutter:	Furnished with distillate and kerosene burning engines; available for other engines if desired.

Description

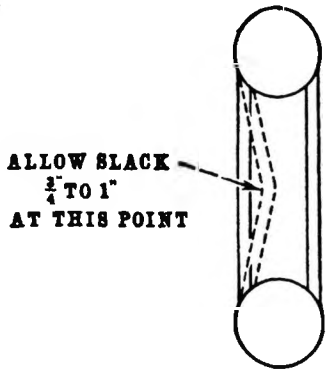
Cooling water is circulated through the engine block, cylinder head and radiator by thermosiphon method. As the engine warms up the water is heated, expands and circulates down through the radiator where the water is cooled before again circulating through the engine (Illust. 25).

Radiator

The radiator is an IH flat-tube type enclosed in a grille and fan shroud. The grille is quickly removed for cleaning by removing 3 fastener screws. Two 7/16-inch studs and pads secure the radiator at the bottom and a brace secures the top of the radiator to the engine. Upper and lower hose connections complete the mounting. A single drain plug in the water inlet elbow drains the entire system.



Illust. 25. Front end of tractor or power unit showing radiator and fan.



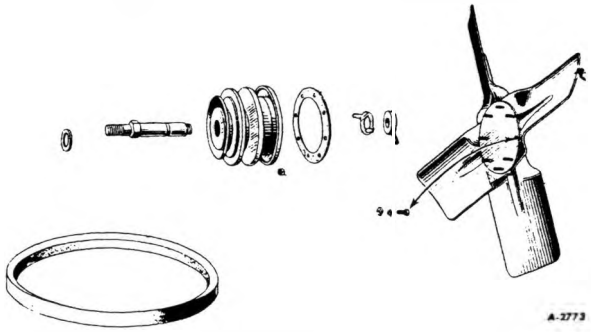
Illust. 26. Method of checking fan belt tension.

Fan

The fan is mounted by its spindle in a slot in the fan bracket and water outlet on the cylinder head. Adjustment of the fan belt is made by moving the fan spindle up or down in its mounting slot. See Illust. 26 for correct fan belt tension. The fan pulley has a double groove, one for the fan V-belt, the other for the generator V-belt, when used.

Two types of fan assemblies are used on this series engine, those using hub number 28318-D and 70210-D, the fan assembly using 70210-D hub, being optional from serial number 101117 and up. Complete assemblies will interchange, but simple parts will not interchange between assemblies.

Lubrication of either type fan hub is accomplished by removal of oil retaining plug and filling the hub 1/4 full of the same weight oil as used in the engine.



Illust. 27. Exploded view of fan assembly.

When wear occurs the spindle, bronze thrust washer, hub, and thrust nut should be replaced on the 28,000 (Illust. 27) numbered assembly; for the 70,000 numbered assembly the replacement parts would be the spindle, bearing, oil impeller and front cap. Gaskets on both types of hubs must be oil tight. After completely assembled the spindle should have a minimum amount of end play and should turn freely with no noticeable drag. Service fan hubs are reamed to size and unless burred or damaged will give proper fit on the spindle.

Heat Indicator and Radiator Shutter

Heat indicator and radiator shutters are regular equipment on distillate or kerosene burning engines. Shutters are manually controlled from the tractor seat. Heat indicators and radiator shutters are also available for other engines if desired.

Cooling of Engine for No. 22 Harvester-Thresher

The No. 22 Harvester-Thresher attachment engine cooling system differs from the other engines of this series as follows:

A pressure type radiator is used and the water capacity of the system is 4-1/2 gallons. A pressure cooled system will not operate properly unless the system is pressure-tight. The pressure control type filler cap must be turned down tight on its gasket and there must be no loose hose connections or leaks. Pressure must be maintained or loss of water and consequent overheating will result.

The slotted fan bracket and radiator are mounted on the flywheel housing. The fan is V-belt driven from the flywheel. The fan belt may be replaced by removing the clutch housing and fan pulley assembly; the belt may then be slipped over the flywheel (Illust. 48).

ENGINE LUBRICATION SYSTEM

SPECIFICATIONS

Type	Pressure system
Pump (gear type):	
Drive	Gear driven from camshaft
Body gears running clearance, in.	.0053 to .0083
Body gears end clearance, in.	.0035 to .006
Oil pressure at 1400 rpm, lb.	50 to 60
Pressure regulator valve (in pump base):	
Valve spring, free length:	2-15/32 in.
Valve spring, tension test	26 lb. at 1-5/8-in.
Oil filter element ("umbrella" type):	
Material	Resin impregnated paper
Replacement interval, hours	120
Crankcase capacity qt.	5

Description

The engine lubricating oil is taken from the oil pan up through a floating, screened intake to the pump. This floating intake takes the oil from near the surface of the oil in the pan so that sediment or dirt which may have accumulated in the bottom of the oil pan is not picked up. The floating intake is pivoted from the oil pump base and must be free to move up and down.

Pressure in the oil distribution lines, built up by the oil pump, is controlled by a spring-loaded regulator valve in the base of the oil pump. The oil distribution line leading from the oil pump consists of drilled passages in the crankcase to the crankshaft, camshaft and to the oil filter base. A portion of the oil delivered by the pump passes through the filter element, the amount being regulated by the hole in the filter case retaining bar. Oil which passes through the filter element is returned to the oil pan.

From the crankshaft bearings, oil is delivered through drilled passages in the shaft to the connecting rod bearings. Oil thrown from the connecting rod bearings and crankshaft lubricates the piston pins, cylinder walls and valve tappets.

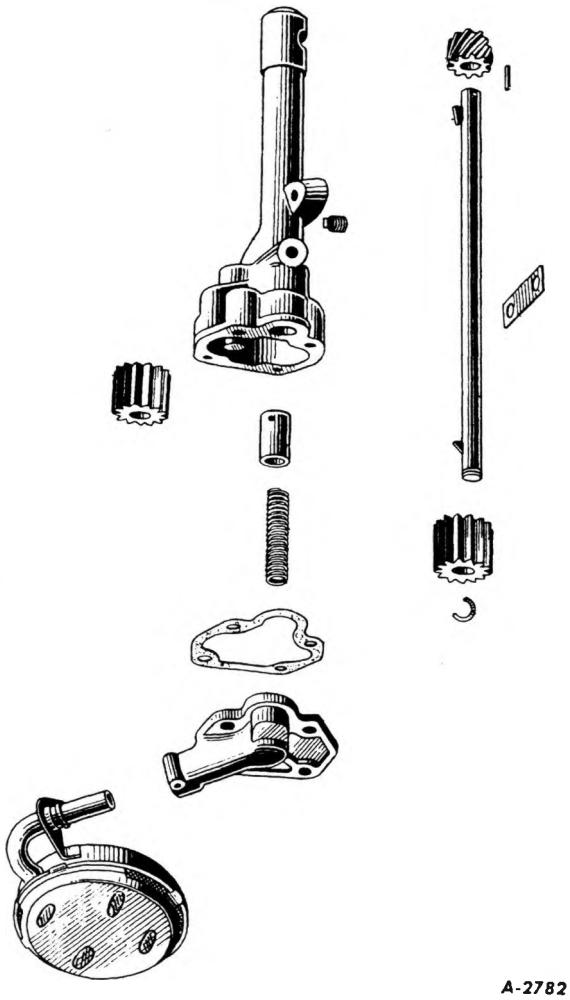
From the camshaft center bearing a driller passage leads up to the cylinder

head, through the head to the valve lever shaft. The flow of oil is metered to the valve lever shaft by a slot in the camshaft journal which allows a small quantity of oil to flow each revolution of the camshaft.

The timing gears and governor are lubricated from the front camshaft bearing. A drilled passage in the camshaft journal connects with the bearing oil hole each revolution of the shaft, allowing a metered flow of oil out to the camshaft thrust plate and gear. Oil thrown from the gear lubricates the governor and governor pinion bushing.

Oil Pump

The oil pump is attached to the crankcase with two cap screws locked with a metal strip. The pump is driven from a spiral gear, which is a part of the camshaft. The oil pump drive shaft extends down from the spiral driven pinion through the oil pump body to the base which incloses the two oil pump body gears, one of which is keyed to the drive shaft. The second body gear is an idler (Illust. 28).



A-2782

Illust. 28. Exploded view of oil pump.

To disassemble the oil pump, remove the cover from the pump body. Then thoroughly clean all parts. Inspect the idler gear for wear on its shaft and the drive shaft and gear for wear in the pump body casting which provides the bearing surface for the drive shaft. Also check end clearance between the body gears and cover.

The running clearance between the gear diameters and the body, and the end clearance between the gears and the body cover are the two main factors controlling the output of the pump. Replace worn parts to bring clearances back to normal, as given in the specifications.

Since the normal output of the oil pump is many times the normal requirement of the engine lubricating system, and all the oil cannot escape through the engine bearing clearances and metered passages, a spring-loaded regulator valve is employed to release the excess oil and maintain a pressure of 50 to 60 lb. at 1400 rpm. This piston type valve and spring should also be inspected after removing the pump body cover. The valve should slide freely in the body bore and the spring should be straight so that the valve will not be cocked in the body bore or on its seat.

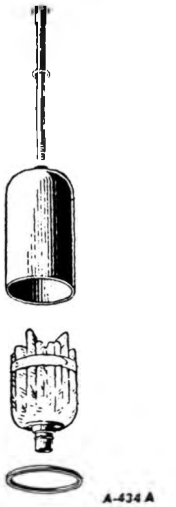
The free length of the pressure regulating valve spring will give some indication of its condition. However, the best test to determine the spring's tension is to load it with the weight specified and measure its length at that load. If this tension length test is below specifications the spring should be replaced.

Crankcase Breather

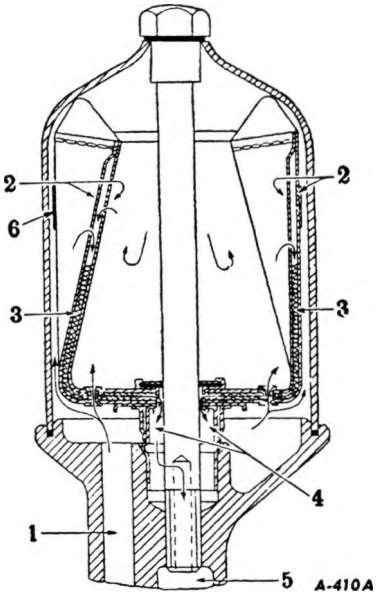
The crankcase breather and filler cap has an oiled wire gauze filler which acts as a dust filter for crankcase ventilation. This breather should be cleaned and reoiled each time the engine oil is changed (120 hrs.). Should the breather become clogged from neglect, leakage will occur at the crankshaft oil seals because of the pressure built up in the crankcase.

Oil Filter

The oil filter element is a Purolator umbrella type renewable filter, which has a large filtering area (Illusts. 29 and 30). Elements should be renewed each time the engine oil is changed. The star-shaped element was used in first production from engine serial Nos. 501 to 97937. The improved umbrella type was first used in production on engine serial No. 97938. The improved umbrella filter element No. 63858-D should be used in engine Nos. 501 to 97937, and element No. 63855-D is used in engine Nos. 97938 and up.



Illust. 29. Oil filter parts.



Illust. 30. Cross-section of oil filter showing (1) oil inlet; (2) element; (3) filtered oil return; (4) filtered oil passage; (5) opening to oil pan; (6) band.

FUEL SYSTEM

SPECIFICATIONS

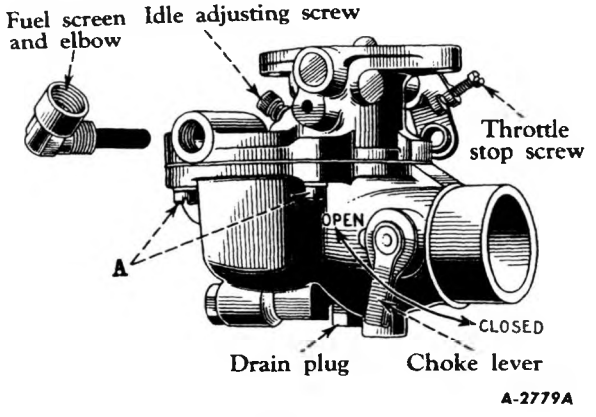
Fuel tank:	
Tractor, gals	10
Power unit when tank is used), gals	7
Starting fuel tank (distillate or kerosene engine), gals	1
Carburetor size, in	7/8
Fuel feed to carburetor	Gravity
Air cleaner:	Oil washed wire filter
Air cleaner oil cup capacity, pints	3/4
Manifold:	
Gasoline or gas engines	Hot spot
Distillate, kerosene engines	Adjustable heat control
Intake manifold inside diameter, in	1
Exhaust stack (standard pipe), in. pipe), in	1-1/2
Muffler	Furnished as Attachment
Stud nut tension, ft. lb	25
Governor (IH)	Flyball, variable speed
Governed speed:	
Tractors (production), rpm	900-1400
Power unit (production), rpm	1000-1800
Harvester-thresher attachment, rpm	900-1575

Carburetor

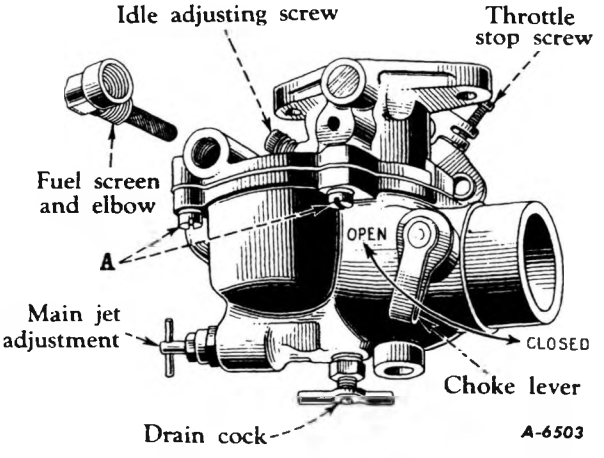
Description

The function of a carburetor is to meter the required amount of fuel to meet the varying demand of engine load and speed and to distribute this fuel into the air stream in as fine a condition as possible. The air-fuel ratio is not constant for all loads and speeds. The carburetor must be able to supply a rich fuel mixture for idle and low speeds; slightly leaner fuel mixtures for full-load operations at full speed; and the leanest fuel mixtures for part-load operations at medium speeds.

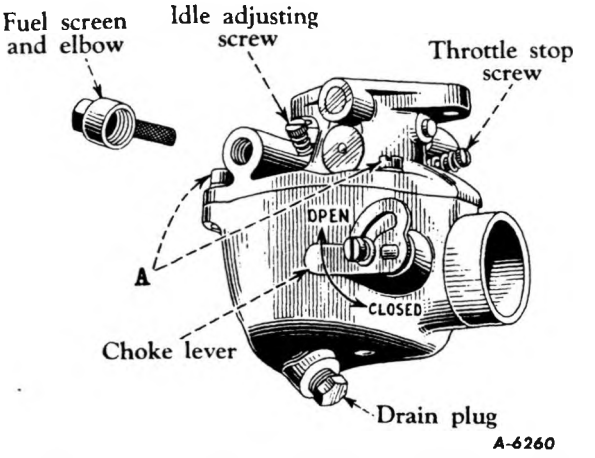
Modern carburetors with their air-bleed-well method of compensation will give these proportionate air-fuel mixtures to meet the load-speed demand, and do not require changes in adjustment by the operator to meet these varying conditions. In fact, carburetors furnished for use with a single type of fuel (gasoline) have no provision for main jet adjustment. Only the carburetors fur-



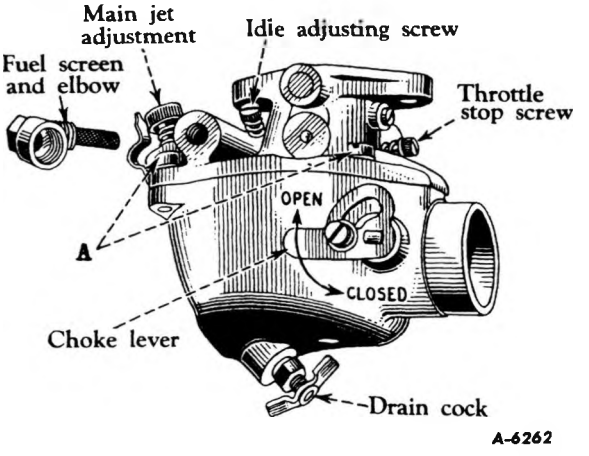
Illust. 31. Zenith gasoline carburetor.



Illust. 32. Zenith distillate carburetor.



Illust. 33. Marvel Schebler gasoline carburetor.



Illust. 34. Marvel Schebler distillate carburetor.

nished to handle kerosene or distillate have a variable adjustment for the main jet; it is used only when changing from one basic fuel (kerosene, distillate, gasoline) to another.

Farmalls A, B, and U-2 series engines are equipped with either Zenith Model 161 (Illusts. 31 and 32) or Marvel-Schebler Model TSX (Illusts. 33 and 34) carburetors. In both makes two types are used, one type for gasoline burning engines and one type for kerosene and distillate burning engines. The principal difference is in the addition of a main jet variable adjustment to the kerosene and distillate carburetors. The carburetors of both types and makes are updraft, plain-tube, single-venturi type having an air-bleed-well method of compensation, and are dust proof.

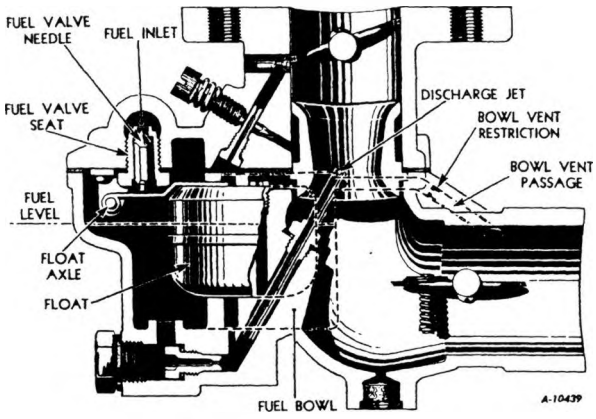
The function of the carburetors will be discussed by breaking them down into the following systems or parts: the fuel supply system, the idle system, the load system, and the choke system.

Fuel Supply System (Illust. 35)

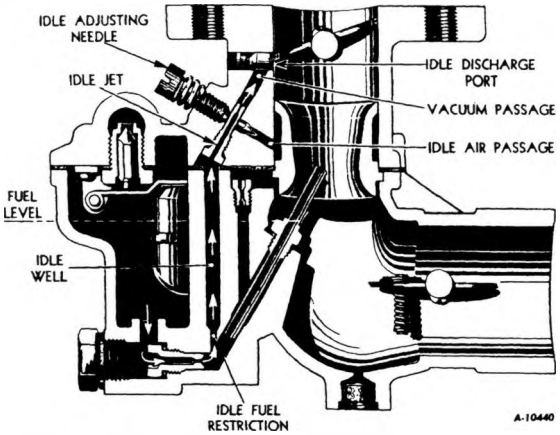
Function of the float system. The float system maintains the correct level of fuel in the fuel bowl under all operating conditions. The correct fuel level together with proper ventilation of the fuel bowl will supply the different systems with the correct amount of fuel necessary for good operation.

The fuel bowl, which surrounds the central location of the discharge jet and metering well on three sides, assists in maintaining a constant level of fuel on the metering system. The engine will operate at angles up to 20 degrees without flooding or affecting air-fuel mixtures.

The relation of the fuel level to the jets is of utmost importance. If the level is too high; flooding might occur; or if it is not quite high enough to flood, the mixture will be too rich. Similarly, if the level is too low the mixture will be lean.



Illust. 35. Sectional view of carburetor showing float system.



Illust. 36. Sectional view of carburetor showing idle system.

The duplex float. The float assembly used is of the duplex type, consisting of two float bodies assembled to a double ended float lever. The two floats maintain practically a constant level of fuel on the metering system throughout the various operating angles in which the engine may be placed.

The fuel valve and seat. The fuel supply line is connected to the fuel inlet. Fuel passes through the fuel valve seat and into the fuel chamber. When the amount of fuel reaches a predetermined level it causes the float to rise and push the fuel valve needle against its seat and thus stop the inflow of fuel.

Operation of the float and valve. When the engine is running and fuel flows from the fuel chamber to the jets of the metering systems, the fuel valve assumes a position with just enough valve opening to supply the required amount of fuel to keep the fuel level constant. The valve opening is greater at higher engine speeds than for idling because of the engine's demand for a larger volume of fuel.

The wear on the fuel valve seat and fuel valve needle is directly influenced by operating conditions such as an excessive amount of shock and vibration.

Effect of restricted air cleaners. Air for ventilation of the fuel bowl (float chamber) is provided through a vent passage located in the carburetor air entrance and a connecting vent passage through the throttle body into the fuel bowl. Air for idling is also taken from the carburetor air entrance and connected to the inside of the air cleaner.

This design eliminates enriching of the air-fuel mixture when the air cleaner becomes restricted due to accumulation of dirt. This method of ventilating the fuel bowl is commonly referred to as an inside or balanced vent. The ratio of air and fuel will remain approximately the same in a balanced carburetor despite the condition of the air cleaner. Any air admitted into the fuel bowl except that which is provided through the vent passage will automatically break the balance of the carburetor and allow the air-fuel mixture to become enriched if dirt in the air cleaner becomes restricted. To properly maintain this balance, the carburetor must have a tight seal between the fuel bowl cover and fuel bowl.

Idle System (Illust. 36)

Function of the idle system. The idle system controls the mixture at closed throttle positions to idle the engine and at slow speeds until the throttle is opened wide enough to allow the main metering system to function. It is independent of the other systems. This system consists of an idle discharge port located in the side of the throttle body, an idle jet to meter fuel, a vacuum passage connecting with the idle port, and an idle air adjusting needle.

Throttle opening for idling. At idling speeds of the engine the throttle plate is slightly advanced from a completely closed position leaving about one-half of the area of the idle discharge port in the side of the throttle body bore revealed to the suction in the engine manifold. This suction is transmitted to the idling jet through a passage running through throttle body.

Operation of the idle system. Fuel from the fuel bowl chamber flows through the main jet into the metering well. Fuel for idling flows from this well through the idle fuel restriction at the

lower end of the well, then through the idle fuel restriction at the lower end of the well, and finally through the idle jet calibration.

The idle well is restricted at the bottom to control the amount of fuel delivered to the idle system and to prevent this system from being effective at higher engine speeds. As the fuel leaves the idle jet and enters the vacuum passage leading to the idle discharge port, is is mixed with a variable amount of air admitted from behind the venturi through the idle air passage.

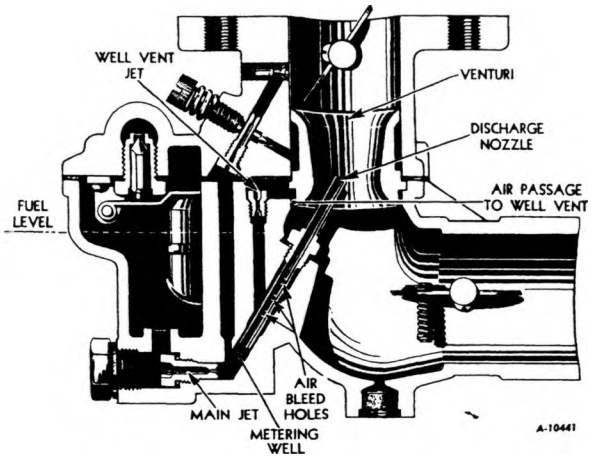
Turning the idle adjusting needle screw towards the seat increases the suction on the idle jet and, hence, more fuel flows through the calibration. The idle air-fuel mixture is also influenced at the same time by the reduced volume of air admitted past the idle adjusting needle when it is turned towards its seat.

Turning the idle adjusting needle screw away from the seat reduces the suction on the idle jet and as a result less fuel flows through the idle jet. The reduced volume of fuel is mixed with an increased amount of air admitted past the idle adjusting needle, thus forming a leaner air-fuel mixture.

Relation of the idle system to load system. As the throttle plate opening is increased, more of the idle discharge port is revealed to the engine suction and more air passes the throttle plate. This arrangement permits the correct mixture of fuel to air to be maintained at the various throttle openings.

When the throttle plate is a short distance beyond the idle port sufficient air passes the plate to start the load system functioning. As the throttle plate is opened wider the idle system gradually ceases to function and less fuel is delivered to the engine by this system. The delivery of fuel through the load system increases as the throttle plate is advanced to wide open position.

Although the delivery of fuel through the idle system diminishes as the throttle approaches the wide open position, it continues to deliver a small volume of fuel, contributing to the fuel delivered by the load system. It cannot be said that the idle system ceases to deliver fuel entirely at wide open throttle, but it must be made clear that the amount of fuel delivered from the idle system at wide open throttle is so small as to be relatively unimportant.



Illust. 37. Sectional view of carburetor showing load system.

The idle discharge port plug is not considered a serviceable part and when pressed into the throttle body it becomes part of the casting forming the idle discharge port. These plugs should never be removed in servicing the carburetor because they are destroyed in removal and new plugs would require calibration after installation.

Load System (Illust. 37)

Function of the load system. This system controls the mixture at part throttle load and the mixture at wide open throttle, full load. It consists of a main venturi controlling the maximum volume of air admitted into the engine; the metering jet (main jet) (with variable adjustment on Kerosene distillate carburetors) which regulates the flow of fuel from the float chamber to the main discharge nozzle; a compensating air bleed (well vent jet) which maintains uniform mixture ratio under changing loads and engine speed; and the main discharge nozzle which delivers the fuel into the air stream.

Operation of the load system. As the throttle plate is opened past the idle position an increasing amount of air is drawn through the venturi. The velocity of the air is speeded up at the point of smallest diameter in the venturi where the outlet of the discharge nozzle is located.

The effect of the venturi is to increase the vacuum at the discharge nozzle. The float chamber and metering well, being vented permits normal pressure on the fuel, causing it to flow through the main jet into the metering well and out through the discharge nozzle where it is delivered into the air stream.

The main jet is so calibrated (or adjusted on kerosene and distillate engines) as to meter the maximum amount of fuel to the metering well necessary for full load. When the engine is stopped or idling, the level of the fuel in the metering well and discharge nozzle is similar to the level in the fuel bowl.

As the load system goes into operation with increased load and throttle plate opening, the fuel is taken from the discharge nozzle at a higher rate than supplied to the well by the main jet, thereby lowering the level of fuel in the metering well. As the load and throttle opening is increased further, the fuel level in the metering well is lowered, uncovering a greater number of air bleed holes in the nozzle and admitting an increasing amount of air from the well vent jet.

This well vent jet meters air into the well in the same manner as the main jet meters fuel. This metered addition of air to the discharge nozzle is necessary to compensate for the fact that the vacuum produced at the nozzle increases out of proportion with the increased velocity of air through the venturi. Were it not for the metered introduction of air into the nozzle, to lean out the mixture, the proportion of fuel to air would steadily increase with the throttle opening, producing an extremely rich mixture at full throttle opening.

A small additional amount of fuel is necessary to insure rapid response from the engine on acceleration. When the throttle is suddenly opened the resulting rush of air through the venturi picks up this extra fuel which remains above the main jet in the metering well at part throttle operation.

Choke System

Effect of cold on starting. In cold weather the effect of low temperatures makes starting a gasoline engine a very involved problem. A cold battery has lost some of its power. This power is needed more as lower temperatures are encountered because the oil in the engine cylinders and bearings becomes heavy, increasing the turning effort necessary to crank the engine.

Starting requires a large quantity of fuel. Under these conditions of low air, manifold, and cylinder temperatures, it is necessary to supply a very rich mixture. Only the "light ends" or more volatile portions of the fuel can be vaporized because of the cold and limited suction at low cranking speeds. Consequently, it is necessary to supply a very large quantity of fuel so enough "light ends" will be vaporized to produce a sufficient amount of ignitable vapor to start the engine running.

Function of the choke valve. The choke system consists chiefly of a valve (air shutter) mounted on a shaft located in the air entrance and operated externally by a lever mounted on the shaft. The choke valve is used to restrict the air entering the carburetor and to increase the suction on the jets when starting the engine. The choke valve in the carburetor is of semi-automatic type, manually operated by the driver. It has a poppet valve incorporated in its design, which is controlled by a spring. The poppet valve opens automatically when the engine starts, admitting air to avoid over-choking or flooding of the engine.

Mixture ratio for starting. The mixture ratio required for starting is considerably richer than that needed to develop maximum power in a hot engine. At the slow cranking speed of the cold engine very little suction exists and under this condition a mixture of approximately 300 parts of fuel to 100 parts of air must be supplied.

As the engine fires and the cranking speed and suction are increased the mixture ratio must be rapidly reduced down to approximately 28 parts of fuel to 100 parts of air. This change is accomplished through the manual adjustment of the choke valve by the operator and the automatic opening of the poppet valve admitting additional air when the engine fires.

Control of starting mixture. It is almost impossible to provide an ideal mixture during the cranking period and then change rapidly to the mixture necessary to keep the engine running by the operator's manipulation of the choke valve alone, because only a slight degree of movement of the valve will make a big change in suction.

The semi-automatic feature (poppet valve) of the choke assists the operator to obtain the proper starting mixtures by making the adjustment of the choke valve less sensitive to manual adjustment. The spring-loaded poppet valve opens automatically with the speed and load of the engine and assists in maintaining the proper mixture to keep the engine running.

FUEL SYSTEM

Service: Zenith Model 161 x 7 Carburetors

Disassemble (Illust. 38)

Before proceeding with the following operational steps, the outside surfaces of the carburetor should be cleaned of dirt and grease so that the solvent used to clean the dismantled parts will not become contaminated.

1. Remove the idling adjusting screw (26) and spring (27), using the fingers or a small screwdriver.

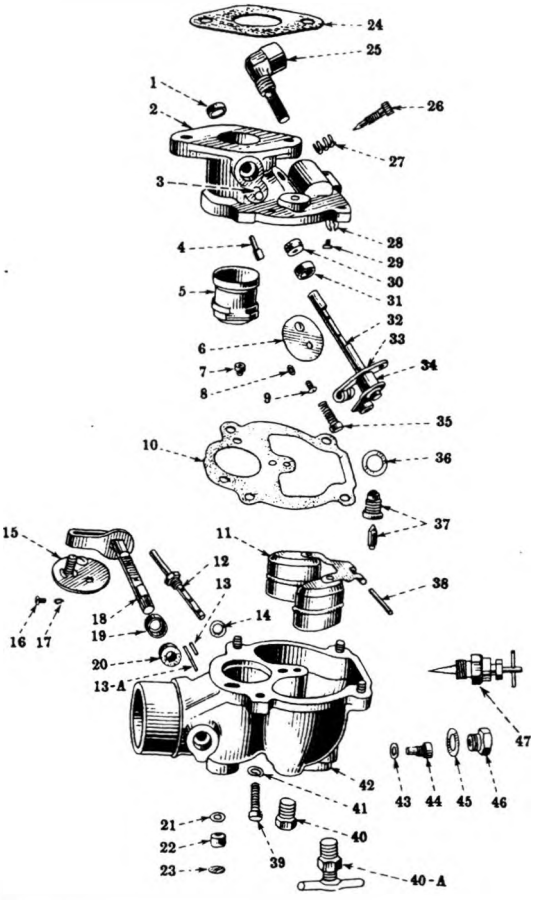
2. Remove the main jet passage plug (46), or main jet adjustment (47) as the case may be, and fiber washer (45), using a 1/2-inch open-end wrench.

3. Remove the main jet (44) and fiber washer (43), using a pronged carburetor socket or a wide blade screwdriver so that the jet is not damaged.

4. Remove the bowl drain cock (40-A) or plug (40) using a 13/32-inch open-end wrench for the drain cock, or a 7/16-inch wrench for the drain plug. NOTE: In some cases the drain plug may have a screwdriver slot instead of a hex head.

5. Remove the fuel screen and elbow fitting (25) using a 9/16-inch open-end wrench.

6. Remove the four bowl to body assembly screws (39) and lockwashers (41), using a screwdriver.



Illust. 38. Exploded view of Zenith carburetor.

JET IDENTIFICATION

Used On	IH Number	Zenith Number	Venturi	Main Jet	Idle Jet	Discharge Nozzle	Well Vent Jet	Fuel Valve Seat	Main Jet Adj. & Drain Cock
Tractors Gasoline	52499 DB	0-9752	15	18	18	50	22	25	No
Tractors Kero-Dist.	48616 DC	0-9749	15	19	18	50	22	25	Yes
U-2 Kero-Dist.	60285 DA	0-9748	17	21	18	55	24	25	Yes
U-2 Gasoline	54214 DB	0-9750	17	21	18	55	26	25	No
No.22H-T Att.	68779 D	(Same as 52499-DB with fuel elbow turned 180°.)							No

Both IH and Zenith numbers are stamped on metal identification disc attached by rivet to fuel bowl cover of each carburetor. Check jet numbers with above specifications.

7. Lift the throttle body (2) and gasket (10) clear of the bowl, being careful to avoid damaging the float (11).

8. Remove the float axle (38), using a screwdriver to push the axle from the slotted end of the float hinge bracket, and the fingers to remove it the rest of the way.

9. Remove the float (11) and the fuel valve needle (part of Item 37).

10. Remove the venturi (5) and the bowl to body gasket (10).

11. Remove the fuel valve seat (37) and fiber washer (36), using a pronged carburetor socket or wide blade screwdriver.

12. Remove the idling jet (4) using a small screwdriver (3/16-inch blade).

13. Hold the throttle in closed position while you remove the throttle plate screws (9), lockwashers (8) and the throttle plate (6) using a small screwdriver.

14. Remove the throttle shaft and lever assembly (32) and the lever spacer (33).

15. Remove the throttle shaft packing washer (30) and the retainer (31), using a screwdriver to pry the retainer.

16. Do not remove the identification disc, float hinge bracket (28), drive screw (29), stop pin (3), shaft hole plug (1), priming hole plug or channel plug. (These items are included in Item 2).

17. Remove the well vent jet (7) from the upper surface of the fuel bowl, using a small screwdriver.

18. Remove the discharge jet (12) and fiber washer (14), using a deep socket, 5/16-inch hex.

19. Before removing the air shutter parts, it is suggested that the casting and the lever be match-marked with a file or prick punch to indicate the side on which the lever is located; also, to avoid confusion at re-assembly, the position of the relief valve in the air shutter plate in relation to the air intake should be noted.

20. Hold the air shutter in the closed position while you remove the air shutter screws (16) and lockwashers (17).

21. Remove the air shutter plate (15). NOTE: Do not remove the relief valve from the air shutter plate which should be serviced as a unit.

22. Remove the air shutter shaft and lever (18).

23. Remove the shaft packing washers (20) and retainers (19) from both sides of the air intake, using a screwdriver to pry the retainers out.

24. Do not remove the air shutter stop pins (13, 13A) or the intake drain drip parts (21, 22, 23).

Clean and Inspect Parts

25. Clean all metal parts in a good solvent. Gum or varnishlike coating from evaporated fuel are often found inside the carburetor. Such coatings restrict the flow of fuel through the jets and passages and must be removed to restore satisfactory operation. A number of good commercial gum solvents are available, or a solution of half and half alcohol and benzol or pure acetone will dissolve these gum coatings. After the gum has been dissolved, rinse in cleaning solution and blow through each channel and jet opening (both directions) with compressed air to make sure channels are clear.

CAUTION: Never use a wire or drill to clean out the calibrated openings in jets.

26. Check parts of carburetor as follows:

(a) Main castings. Examine for damaged or broken flange or badly worn shaft openings. Replace if necessary.

(b) Float. Replace the float if loaded with gasoline, damaged, or if the float axle bearing is worn excessively. Inspect the top side of the float lever hinge for wear where it contacts the fuel valve needle.

(c) Float axle. Replace if any wear can be detected on the bearing surfaces.

(d) Fuel valve and seat. Replace as both parts wear and may cause improper fuel level.

(e) Idling adjusting screw. Inspect the point of the screw. This must be smooth and free of ridges.

(f) Throttle plate. Inspect the plate for burrs or damaged edges. Never clean the throttle plate with a buffing wheel or a sharp instrument.

(g) Air shutter (choke). Inspect the plate for bends, burrs or damaged relief valve.

(h) Shaft. Inspect for wear on bearing surfaces. See that the shafts are straight.

(i) Gaskets. Replace all gaskets and fiber washers each time the carburetor is disassembled.

(j) Shaft packings. Replace packing washers and retainers to insure a snug fit to prevent dust entering the engine at these points.

(k) Venturi and jets. These parts are stamped to indicate the size of the calibrated openings. Check with the chart to verify correctness of sizes. Replace if damaged, particularly if the calibrated orifice appears to have been damaged by wire or drill in previous cleaning operations.

Reassemble

27. Install the air shutter shaft packing washers (20) and retainers (19).

28. Refer to the match-marks on the lever and the body (step 19) and install the air shutter shaft and lever assembly (18).

29. Hold the lever in the closed position, place the air shutter plate (15) in position with valve ddown and the valve stem and spring towards the open end of the air intake.

30. Start the air shutter screws (16) and lockwashers (17) into the shaft, using small screwdriver. NOTE: This operation can be simplified if the screwdriver is wedged into the screw slot with a piece of paper or cloth, until the screw has been started into place.

31. Be sure the air shutter plate is properly centered and the screws securely tightened, then recheck operation of the air shutter. It should open and close freely.

32. Install the discharge jet (12) and new fiber washer (14), using a deep socket, 5/16-inch hex.

33. Install the well vent jet (7) in upper surface of the fuel bowl, using a small screwdriver.

34. Install the throttle shaft packing washer (30) and retainer (31).

35. Place the lever spacer (33) on the throttle shaft.

36. Install the throttle shaft and lever assembly (32). NOTE: Be sure that the throttle lever stop screw (35) is unscrewed until it is flush with the lever so it can not prevent complete closing of the throttle plate.

37. Hold the throttle lever in the closed position while you install the throttle plate (6) using procedure suggested in step 30. NOTE: The beveled edges of the plate will fit snugly against the body when the plate is properly centered.

38. When the throttle plate has been properly centered and the screws (9) and lock washers (8) tightened hold the throttle closed and screw in (clockwise) on the stop screw (35) until it just touches the stop pin, then turn the stop screw $1\frac{1}{2}$ complete turns more to hold the throttle slightly open as a preliminary adjustment.

39. Install the idling jet (4), using a small screwdriver.

40. Install the new fuel valve seat (37) and new fiber washer (36), using a pronged carburetor socket or a wide blade screwdriver.

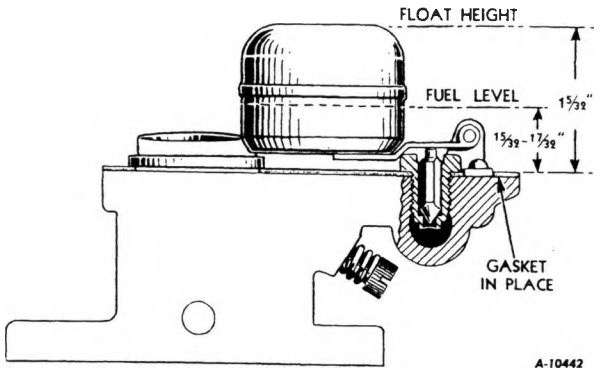
41. Place a new bowl to body gasket (10) in position on the throttle body. Be sure the holes in the gasket coincide with the channels in the casting.

42. Install the venturi (5), inserting the end with the thin edge through the gasket into the throttle barrel. Be sure the venturi is far enough down for its flange to rest on the gasket.

43. Place the new fuel valve needle in the seat. NOTE: Never use an old needle in a new seat, or vice versa.

44. Hold the float (11) in position.

45. Install the float axle (38), using the fingers to insert the tapered end of the axle into the float hinge bracket (on side opposite the slot) and push it through to the slot, then use the handle end of a screwdriver to push or tap the axle into the slotted side of the bracket. NOTE: The axle should be centered in the bracket so it extends evenly on both sides. The float should move freely on the axle with a minimum of side-play.



Illust. 39. Dimensions for measuring fuel level and position of float of Zenith carburetor.

46. Set the float level to specifications using a standard 6-inch depth gauge. CAUTION: Do not bend, twist or apply pressure to the float bodies. NOTE: With the throttle body in an inverted position and viewed from the free end of the float, the float bodies should be centered and at right angles to the machined surface of the throttle body. The float setting is measured from the machined surface to the highest point on the float bodies. The depth gauge should read 1-5/32 inches (Illust. 39).

To increase or decrease the distance between the float body and the machined surface, use long-nosed pliers to bend the float hinge close to the float bodies.

47. Place the fuel bowl (42) in position on the throttle body (2), being careful to avoid damaging the float.

48. Install the four bowl to body assembly screws (39) and lock washers (41), tightening them evenly and securely with a screwdriver. These should be rechecked after a few hours of operation on the engine.

49. Install the fuel screen and elbow fitting (25) using a 9/16-inch open-end wrench.

50. Install the bowl drain cock (40-A) or plug (40), using a 13/32-inch open-end wrench for the drain cock or a 7/16-inch wrench for the drain plug

51. Install the main jet (44) and new fiber washer (43), using a pronged carburetor socket or wide blade screwdriver.

52. Install the main jet passage plug (46), or main jet adjustment (47), as case may be, and a new fiber washer (45), using a 1/2-inch open-end wrench. NOTE: If a main jet adjustment is used, turn the adjusting needle in (clockwise) carefully until it seats, then unscrew it 1½ full turns as a preliminary adjustment.

53. Install the idling adjusting screw (26) and spring (27), using the fingers to start, then a small screwdriver to complete the operation. NOTE: As a preliminary adjustment set the idling adjusting screw at one full turn off the seat.

Service: Marvel Schebler Model TSX

Disassemble (Illust. 40)

Before proceeding with the following operational steps, the outside surfaces of the carburetor should be cleaned of dirt and grease so that the solvent used to clean the dismantled parts will not become contaminated.

1. Remove main jet adjusting screw (1) spring (2) washer and gasket (3 & 4) kerosene-distillate carburetor only.

2. Separate the bowl and throttle body castings by removing the 4 body screws (28) and lock washers (29).

3. Remove the float axle (10), using a screwdriver to push the axle from the slotted end of the float hinge bracket.

4. Remove the float (11) and fuel valve needle (part of item 9).

5. Using a suitable screwdriver, remove the fuel valve seat (9) and gasket (8).

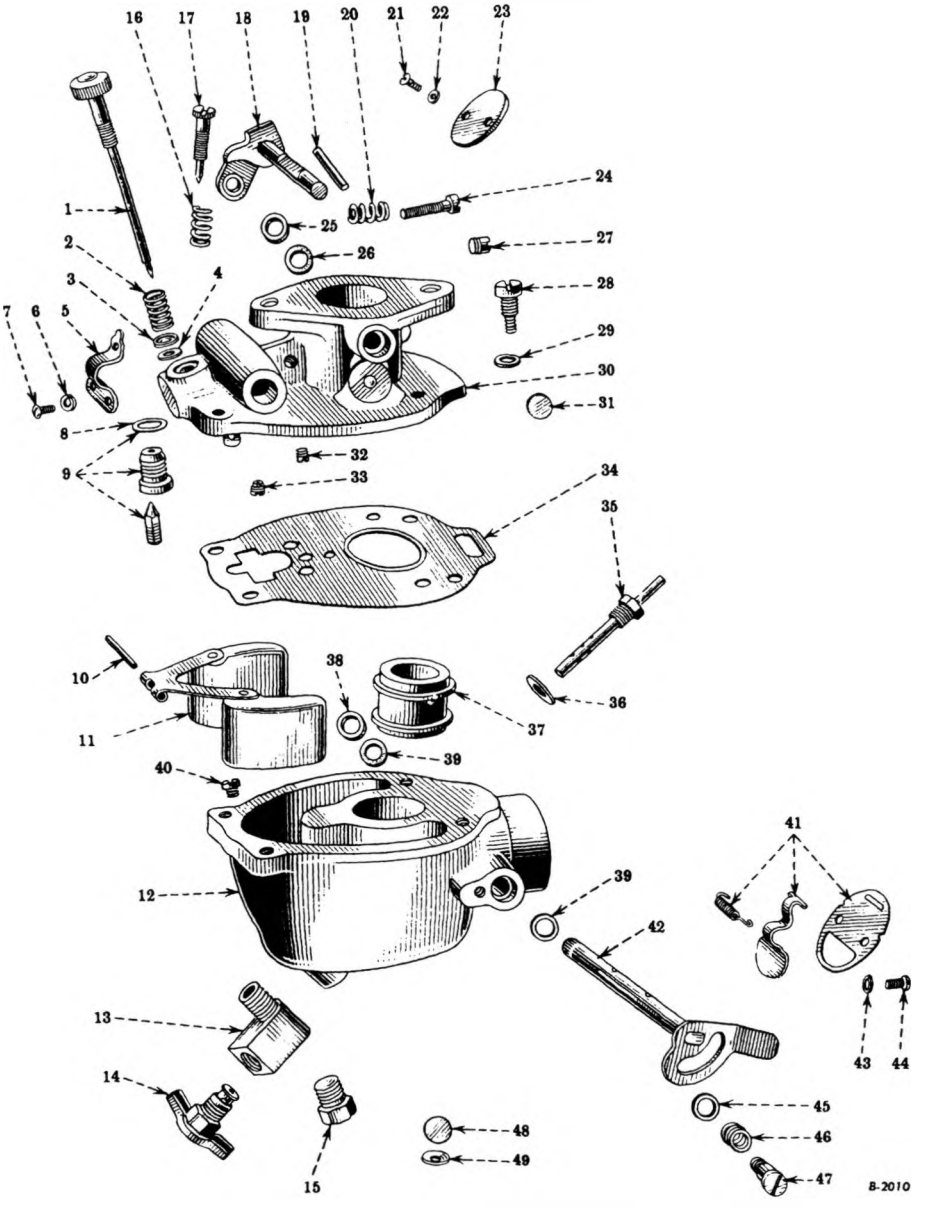
6. Lift out the venturi (37) and body gasket (34).

7. Remove the economizer jet (32), using a long, slender screwdriver.

8. Remove the idle jet (33), using screwdriver.

9. Remove the idle adjusting screw (17) with its spring (16).

10. Remove the fuel inlet elbow and screen assembly, if so equipped.



Illust. 40. Exploded view of Marvel Schebler carburetor.

11. Hold the throttle in closed position, remove the throttle plate screws and lock washers (21, 22) and the throttle plate (23).

12. Before removing the throttle shaft (18), check the fit of the throttle shaft for looseness in the throttle body. If wear is excessive, install a new shaft.

13. Remove the throttle shaft packing and retainer (25, 26).

14. Remove the plug screw (27) and inspect idle holes and economizer vent hole for presence of dirt or foreign matter. The top idle hole can be inspected from the top of casting.

15. Remove the discharge nozzle (35) gasket (36), using a deep socket 3/8-inch hex.

16. Remove the main jet (40), using a suitable screwdriver. This is in the gasoline carburetor only. In the kerosene-distillate carburetor the main jet is pressed in place and calibrated and are not listed as repair parts. Do not remove.

17. The metering well air vent jet is also pressed into the bowl casting and can be readily cleaned by compressed air. This jet is calibrated after installation and is not listed as repair part. Do not remove.

18. Remove bowl drain cock and elbow (13, 14) or plug (15), using suitable wrench.

19. Do not remove the drip hole filter (48) and expansion plug (49) unless the filter is too badly plugged to clean with compressed air. If necessary to replace these parts, be sure the filter fits snugly in the recess and that the new expansion plug is staked firmly in place.

20. Remove the air shutter plate (41) screws and lock washers (43, 44).

21. Remove the choke lever screw (47) spring and washer (45, 46) check the air shutter shaft (42) for wear replace if necessary.

22. Remove the air shutter shaft packing retainer (38) and packings (39).

Clean and Inspect Parts

23. Clean all metal parts in a good gum solvent. Gum or varnishlike coating from evaporated fuel is often found inside the carburetor. Such coatings restrict the flow of fuel through the jets and passages and must be removed to restore satisfactory operation. A number of good commercial gum solvents are available, or a solution of half and half alcohol and benzol or pure acetone will dissolve these gum coatings. After gum has been dissolved, rinse parts in cleaning fluid and blow through each channel and jet opening (both directions) with compressed air to make sure channels are clear.

CAUTION: Never use a wire or drill to clean out the calibrated openings in jets.

24. Check parts of the carburetor as follows:

(a) Main castings. Examine for damaged or broken flange or badly worn shaft openings. Replace if necessary.

(b) Float. Replace the float if loaded with fuel, damaged, or if the float axle bearing is worn excessively. Inspect the top side of the float lever hinge for wear where it contacts the fuel valve needle.

(c) Float axle. Replace if any wear can be detected on the bearing surfaces.

(d) Fuel valve and seat. Replace as both parts wear and cause improper fuel level.

(e) Idling adjusting screw. The point of the screw must be smooth and free of ridges.

(f) Main jet adjusting screw. The point of the screw must be smooth and free of ridges.

(g) Throttle plate. Inspect the plate for burrs or damaged edges. Never clean the throttle plate with a buffing wheel or a sharp instrument.

(h) Air shutter (choke). Inspect the plate for bends, burrs or damaged relief valve.

JET IDENTIFICATION

Used On	IH Number	Marvel-Schebler Number	Venturi Size Inches	Main Jet	Idle Jet	Discharge Nozzle	Economizer Jet	Fuel Valve And Seat	Main Jet Adjustment Drain Cock
Tractors Gasoline	69401 D	TSX-157	5/8	69928 D	69929 D	69968 D	69926 D	69956 D	No
Kero.-dist.	69402 D	TSX-156	5/8	*	69929 D	29968 D	29969 D	29969 D	Yes
U-2 Gasoline	69503 D	TSX-171	11/16	69959 D	69929 D	69927 D	69926 D	69956 D	No
Kero.-dist.	69404 D	TSX-198	5/8	*	69929 D	69968 D	69969 D	69956 D	Yes

Check numbers on the metal identification disc (attached to throttle body) against TSX prefix number in above specifications for correct replacement parts.

* Main jets in kerosene-distillate carburetor are pressed into bowl castings and are not listed as repair parts.

(i) Shaft. Inspect both throttle and air shutter shafts for wear on bearing surfaces. See that the shafts are straight.

(j) Gaskets. Replace all gaskets and fiber washers each time a carburetor is dismantled.

(k) Shaft packings. Replace packing washers and retainers to insure against entrance of dust into the engine at these points.

(l) Venturi and jets. Replace if damaged, particularly if the calibrated openings appear to have been damaged by wire or drill in previous cleaning operations. Use the chart for selecting correct part numbers for various modifications of the TSX carburetor when replacing jets.

Reassemble Carburetor

25. Insert air shutter shaft packing (39) and retainer (38).

26. Insert air shutter shaft (42) and choke lever screw, spring and washer (45, 46, 47), install air shutter plate (41) valve opening side of plate first, valve and spring up, into the shaft. Center the plate in the air inlet bore by moving the choke lever to closed position. While held firmly in this position replace the screws and lock washers (43, 44). Should there be any binding in the movement of the air shutter plate, loosen the screws (44) and recenter the plate.

27. Install the main jet (40) using suitable screwdriver. (Gasoline carburetor only.)

28. Install the discharge nozzle (35) and gasket (36) using a deep socket Hex.

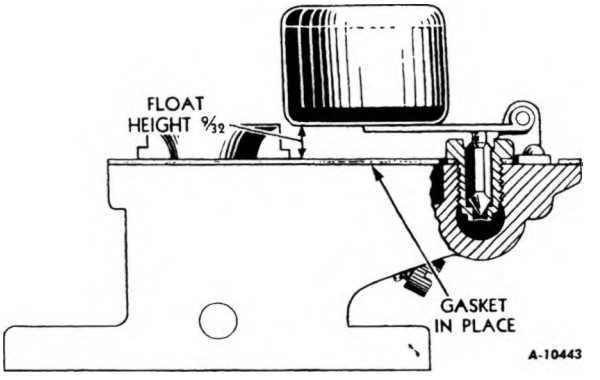
29. Insert the bowl drain plug (15) or drain cock and elbow (13, 14).

30. Insert the inspection plug (27) in the throttle body, and replace the idle jet (33), using a screwdriver.

31. *Install the economizer jet (32),* using a long, slender screwdriver.

32. Install throttle shaft packing and retainer (25, 26) and throttle shaft (18).

33. Assemble the throttle plate (23) on shaft with screws and lock washers (21, 22), before tightening the screws, center the plate by tightly closing the throttle, being sure that the throttle stop screw (24) is backed out to allow the plate to seat firmly in the bore. Then tighten plate screws (21) and check throttle for free movement; should binding occur loosen plate screws and recenter throttle plate. Readjust throttle stop screw to hold throttle plate open slightly. One and one half turns of the stop screw is sufficient for preliminary adjustment.



Illust. 41. Dimensions for measuring fuel level and position of float of Marvel Schebler carburetor.

34. Insert the idle adjusting screw and spring (16, 17). CAUTION: Do not force the idle adjusting screw too firmly against the seat, as it will groove needle point and prevent proper adjustment. The idle adjusting screw should be set about two turns from the seat for preliminary setting.

35. Install the fuel valve seat (9) and gasket (8), and insert the fuel valve (9) in the seat.

36. Place the venturi (37) in the throttle body (30) with the large opening toward the throttle. Put the bowl cover gasket (34) in place.

37. Position the float assembly (11) and insert the float axle (10). Check float for free movement.

3 With the throttle body and bowl cover casting inverted, the distance from the gasket surface to the nearest edge of the float should be 9/32 inches (Illust. 41). To properly position floats to this dimension use long-nosed pliers, bending the narrow sections of the lever midway between fuel valve and floats. The float bodies should be centered and at right angles to the machined surface of the bowl cover.

38. With the throttle body and bowl cover assembly in the inverted position, lower the bowl assembly (12) over the

taking precaution that the venturi (37) guides the bowl into position. With the two assemblies held firmly together, turn the carburetor to upright position and install the four body screws and lock washers (28, 29). Recheck body screws after the engine has been in operation a few hours.

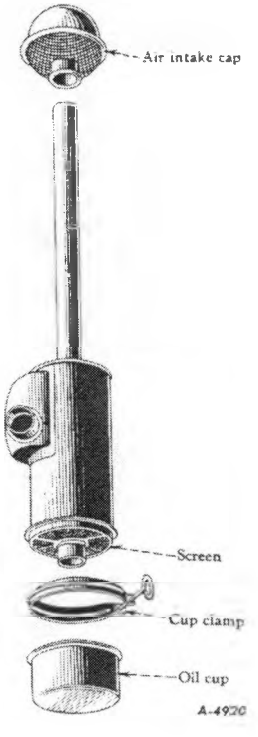
39. Install the main jet adjusting screw (1), spring (2), washer and gasket (3, 4). Seat the screw lightly, and back out approximately one full turn for preliminary setting (kerosene-distillate carburetor only).

40. Assemble the fuel inlet elbow and screen assembly, if so equipped.

41. Install the carburetor on engine, using a new flange gasket.

Air Cleaner

The air cleaner is an oil washed screen type. A heavy screen in the air intake cap prevents large particles from entering the air cleaner. The air then passes down to the oil cup where it goes through a bath of oil. As the air rises through the screens above the oil cup some oil is carried up with it.



Illust. 42. Air cleaner parts.

Fine dust in the air is removed on contact with the oiled screen maze. As the oil from the screens works back down, it carries the dirt with it and the dirt settles in the oil cup. To insure efficient operation the oil in the air cleaner cup must be kept clean. Refill with clean oil of the same S.A.E. number as recommended for the engine every 10 hours of operation and more frequently when operating under dusty conditions (Illust. 42).

The No. 22 Harvester-thresher engine attachment is equipped with a long air cleaner intake pipe, the upper end of which terminates in a frame work covered with an air filter cloth. This extended air intake is necessary to secure air above the normal dust level of the air cleaner with the excessive amount of fuzz, chaff and dust common to all threshing operations.

The filter cloth may be removed for cleaning. A collector type pre-cleaner and/or an air cleaner extension pipe are available as special features for other engines operating in extremely dirty conditions.

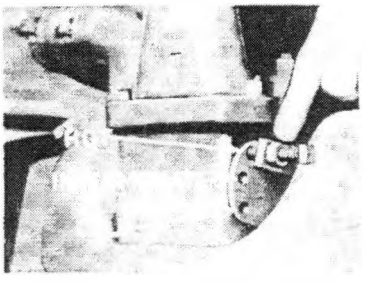
Proper functioning of air cleaners is important to obtain maximum power and engine life. A restricted air cleaner gives the same results as a restricted manifold or a throttle valve which will open only part way, resulting in loss of power.

Thorough cleaning of the screen and all air passages of the air cleaner each 60 hours of operation insure efficient operation. Engine overhaul or tune-up jobs should always include a thorough cleaning of the air cleaner and inspection of all connections for possible leakage of dirty air into the engine.

Manifold

Manifolds are a single cast combination intake and exhaust manifold. The manifolds on gasoline burning engines do not have a heat control valves, nor are they equipped with heat shields. Only a very small portion of the intake manifold is jacketed for exhaust gas heating. This small "hot spot" is necessary to assist in vaporizing the fuel.

The manifold on the distillate and kerosene burning engines is equipped with a shield and in addition the entire intake raiser is jacketed for the circulation of hot exhaust gas. An adjustable heat control valve allows tthe operator to adjust the intake manifold jacket temperature to meet conditions of load, air temperatures and type of fuel used (Illust. 43).



Illust. 43. Intake manifold heat control.

After extended use, the inside surfaces of intake manifolds should be inspected for coke-like deposits which reduce the inside diameter of the manifold. These deposits must be removed as they tend to reduce the amount of fuel-air mixture reaching the engine and, thereby cut down the engine's power.

Manifold gaskets must be in good condition to prevent entrance of dirt into engine and to maintain fuel-air ratio in intake. The manifold is secured to the cylinder head by six 3/8-inch studs and hex nuts. These should be tightened to 25 ft. lb. with a tension indicating wrench.

An exhaust muffler is available as a special feature where the roar of an open exhaust is objectionable. A spark arrester attachment for the exhaust stack is also available as insurance against fire hazards from exhaust sparks.

Engine Governor

Engine governors are designed to maintain a selected engine speed (r.p.m.) within reasonably constant limits under varying load conditions, by proportioning the fuel to the load. The governor of the Farmalls A, B and U-2 series engines depends for its action upon centrifugal force, consisting of a pair of weights rotating about a shaft driven by the engine, and a spring to counteract the centrifugal force or outward movement of the weights. The movement of the governor weights is transmitted to the carburetor throttle valve by suitable linkage.

As the engine is started and its speed increases, the governor weights move outward by centrifugal force until the spring tension, increased by the outward movement of the weights, is equal to the centrifugal force built up in the revolving weights. Thus the governing system is balanced and the engine speed remains constant.

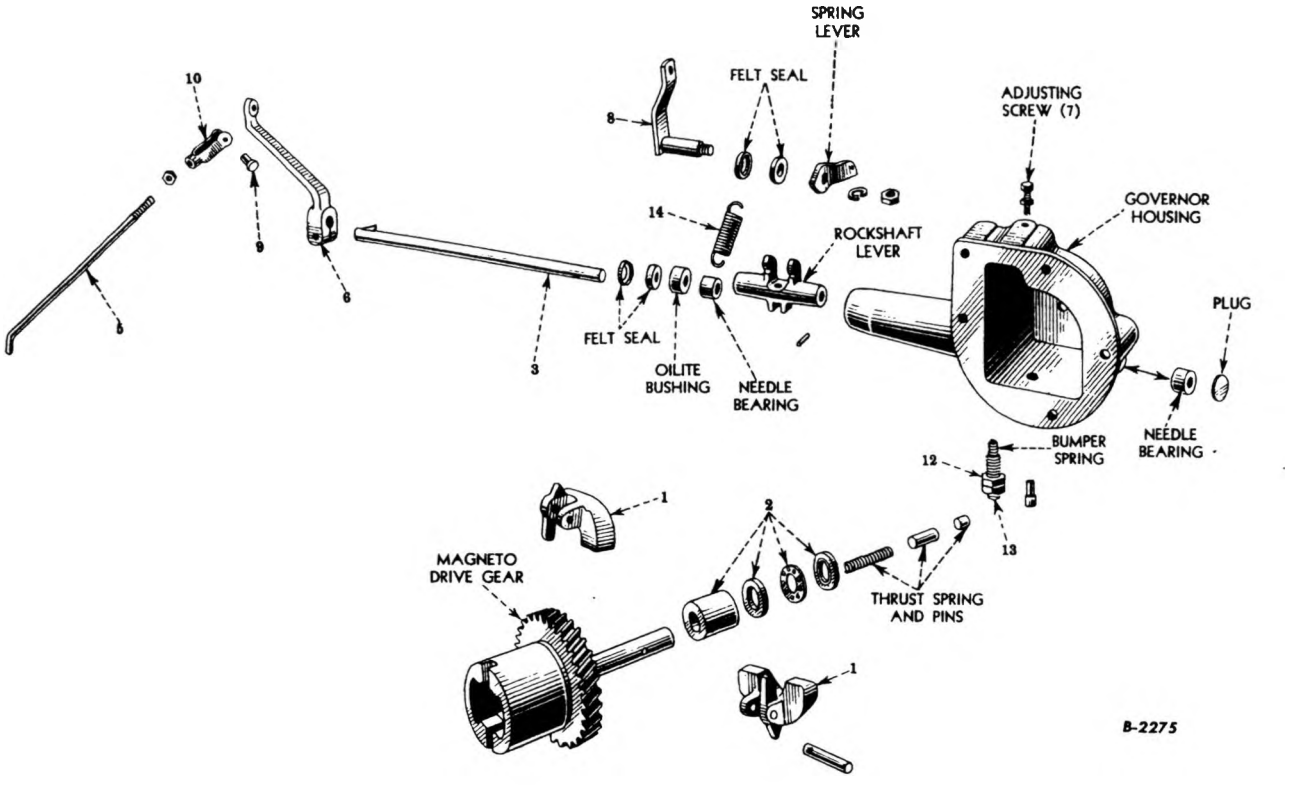
GOVERNOR DATA

Model	R.P.M. Normal Load Governed Maximum Speed	R.P.M. No Load Governed Maximum Speed	R.P.M. Normal Low Idle	Governor Spring Number	Use Rockshaft Lever Hole	Governor Weight Number	Remarks
A, B, AV, BN & Int. A	1400 - 10	1540 - 25	525 - 25	46944 DA	A	6506 D	Production
U-2	1800 - 10	1980 - 25	525 - 25	46944 DA	A	54236 D	Production
Power	2000 - 10	2200 - 25	525 - 25	46944 DA	A	54236 D	Attachment
Unit	1200 - 10	1260 - 25	525 - 25	57287 D	B	6506 D	Attachment
No.22 HT Attachment	1575 - 10	1650 - 25	525 - 25	68928 D	B	54236 D	Production

GOVERNOR SPRING IDENTIFICATION

Part Number	Gauge Wire	No. of Coils	Outside Diameter (in.)	Free* Length (in.)	Length Under Load*
46944-DA	No. 14 (.080-in.)	15	.5625	1015/16	2-1/8-in. under 15.5 lb.
57287 D	No. 14 (.080-in.)	7-1/2	.8125	1-3/8	2-5/16-in. under 21.8 lb.
48928 D	No. 14 (.080-in.)	9	.740	1-13/32	2-33/64-in. under 28.5 lb.

* Length from inside of hook to inside of hook.



Illust. 44. Exploded view of governor.

When changes in the engine load occur the resulting slight change in engine speed causes a small movement (in or out) of the governor weights which open or close the throttle a sufficient amount to maintain a reasonably constant engine speed.

The engine speed is changed by the speed change hand lever increasing or decreasing the governor spring tension and not by direct connection with the carburetor throttle valve.

Increasing the governor spring tension allows the throttle to be pulled further open, thereby increasing the engine speed until the added centrifugal force of the governor weights balances the greater spring tension.

Decreasing the governor spring tension allows the centrifugal force of the weights to close the throttle, thereby decreasing the engine speed until the centrifugal force and the reduced spring tension again balance.

When the governor weights are together with engine stopped and tension on the governor spring the carburetor throttle valve plate (4) should be in the wide open position. (Illust. 45.)

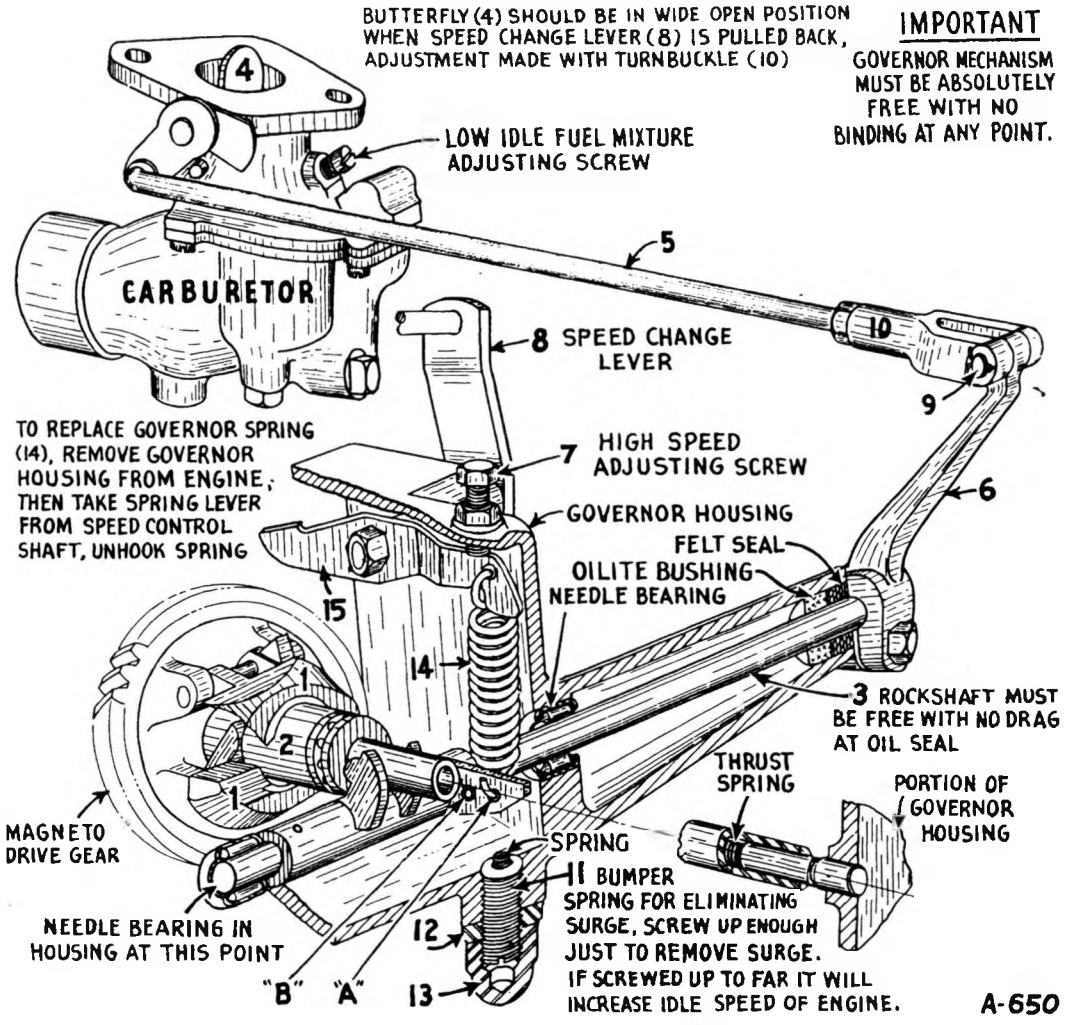
Synchronizing Governor to Carburetor Butterfly

It is very important that the mechanism connecting the governor weight movement to the carburetor throttle is not worn and is correctly adjusted. To check this adjustment place the speed change lever (8) in the wide open position (with engine stopped), remove pin (9) from governor rockshaft arm (6) and carburetor connecting rod yoke (10), then hold both the rockshaft arm (6) and the carburetor connecting rod (5) as far toward carburetor as they will go.

With the two parts in this position pin (9) should slide freely into place. If it does not, adjust the length of the carburetor connecting rod by turning the connecting rod yoke (10) until the pin slides in freely. Be sure that the yoke (10) is tightened.

Maximum High Speed Adjustment

The engine no-load, giverned maximum speed can be corrected by one simple accessible adjusting screw (7) on the top of the governor housing. The no-load, governed maximum speed is defined as the speed at which the engine runs with the


BUTTERFLY (4) SHOULD BE IN WIDE OPEN POSITION WHEN SPEED CHANGE LEVER (8) IS PULLED BACK, ADJUSTMENT MADE WITH TURNBUCKLE (10)
IMPORTANT
GOVERNOR MECHANISM MUST BE ABSOLUTELY FREE WITH NO BINDING AT ANY POINT.
LOW IDLE FUEL MIXTURE ADJUSTING SCREW
CARBURETOR
8 SPEED CHANGE LEVER
TO REPLACE GOVERNOR SPRING (14), REMOVE GOVERNOR HOUSING FROM ENGINE, THEN TAKE SPRING LEVER FROM SPEED CONTROL SHAFT, UNHOOK SPRING
7 HIGH SPEED ADJUSTING SCREW
GOVERNOR HOUSING
FELT SEAL
OILITE BUSHING
NEEDLE BEARING
3 ROCKSHAFT MUST BE FREE WITH NO DRAG AT OIL SEAL
THRUST SPRING
PORTION OF GOVERNOR HOUSING
MAGNETO DRIVE GEAR
SPRING
11 BUMPER SPRING FOR ELIMINATING SURGE, SCREW UP ENOUGH JUST TO REMOVE SURGE. IF SCREWED UP TO FAR IT WILL INCREASE IDLE SPEED OF ENGINE.
NEEDLE BEARING IN HOUSING AT THIS POINT
"B" "A"
A-650

Illust. 45. Schematic drawing of engine governor.

speed control hand lever in wide open position and the engine running without load. This predetermined speed (1540 r.p.m. for Farmall-A) assures the carburetor butterfly valve being in a wide open position when the engine is running at its rated load speed (1400 r.p.m. for Farmall-A). See governor data chart.

To adjust for no-load, governed maximum speed the engine should first be brought up to operating temperature, after which the speed change lever (8) is pulled back as far as it will go, then the adjusting screw (7) is turned out to increase the speed and in to reduce speed. The adjusting screw is locked and sealed. It is advisable to reseal it after making an adjustment.

If a surge or "hunting" occurs at the no-load end of range when the engine is operating at maximum idle speed, stop the engine and adjust the bumper spring screw (11) up just enough to remove surge (one-half turn at a time till surge disappears). Should the bumper spring screw (11) be screwed up too far it will interfere with the low speed adjustment, making it impossible to idle the engine.

Should normal adjustment of the bumper spring screw (11) not correct the surge or "hunting," look for wear on the various parts of the governor which would cause misalignment. Inspect the carburetor throttle shaft for wear or slight drag at extremes of movement; also see that governor rockshaft (3) is free from drag throughout its range of movement.

An improper carburetor mixture adjustment will also cause a surge. Inspect the air cleaner for too heavy oil in the cup or plugged screens which may affect the carburetor mixture.

Low Idle Speed Adjustment

This is the lowest speed at which the engine will run with the speed change lever (8) all the way forward. This is adjusted by the stop screw at the carburetor throttle shaft. Speed should be 525 r.p.m. for all engines in this series.

Disassembly and Assembly of Governor

When replacing governor weights (1) be sure that the proper type of weight is used (see chart) and that the new weights are absolutely free on their pins.

The governor thrust sleeve (2) and bearing must also be free on its shaft.

Care must be taken to prevent bending the hooks of the governor spring (14); the spring lever (15) should be removed from the speed change lever shaft (8) to remove and install the spring. The upper hook of governor spring must be inserted in the spring lever (15) so that the open end of the hook will face the side of governor housing. (Illust. 15.) Assemble the lower end of the governor spring (14) in the "A" or "B" position in the rockshaft lever as given in governor data chart. Be sure the proper type of spring is used.

The governor rockshaft (3) must be absolutely free from drag throughout its range of movement. Two needle bearings and one "Oilite" bushing support the rockshaft, and a felt seal is assembled at the outside of the bushing. The felt seal must not place any drag on the movement of the rockshaft or rockshaft arm (6).

Adjust the linkage between the hand operated lever and the speed change lever (8) so that the latter is assured full travel from the idle speed position to the high speed stop screw (7).

ENGINE CLUTCH

SPECIFICATIONS

Tractors:

Type: Spring-loaded, single-plate, dry disc, foot-operated.
Size, in. 9
Springs, no. used. 6
Release bearing. . . . . Ball thrust
Pilot bearing. . . . . Oilite bushing
Pedal free movement, in. 1-1/2

Power unit:

Type: Overcenter, cam type, single plate, dry disc, hand-operated.
Size, in. 8
Release bearing. . . . . Radial ball bearing
Pilot bearing. . . . . Radial ball bearing

Harvester-thresher attachment:

Type: Spring-loaded, single plate, dry disc, hand-operated.
Size, in. 8
Springs, no. used. 6
Release bearing. . . . . Ball thrust
Pilot bearing. . . . . Radial ball bearing

Tractors

Farmalls A and B series tractors are equipped with a foot operated, spring-loaded 9-inch diameter, single plate, dry disc clutch. Proper lubrication of the release bearing and adjustment to maintain the clutch pedal free movement will insure long trouble-free life. Operator's instructions covering the care of the clutch will be found in the Owner's Manual for each of the tractors.

Inspection of the clutch release bearing and clutch release levers may be made through the opening on the underside of the flywheel housing. For measurements and adjustments see cross-sectional drawing Chart 2. Complete information on the removal and rebuilding of all clutches will be found in the Blue Ribbon Service Training Course Manual No. 10 (form CHS-62).

U-2 Power Unit

The U-2 power unit is equipped with a 9-inch cam type, overcenter, single plate, dry disc, hand operated clutch.

ENGINE CLUTCH

Operator's instructions for lubrication and adjustment to compensate for wear are covered in the Owner's Manual.

The clutch is engaged by moving the hand lever forward (toward engine). It is fully engaged when a definite over-center cam engagement is felt.

If the definite overcenter cam engagement is no longer felt, slippage of the clutch will occur under load; adjustment should then be made as follows:

(1) Remove the clutch housing hand hole cover, either upper or lower, whichever is the more accessible.

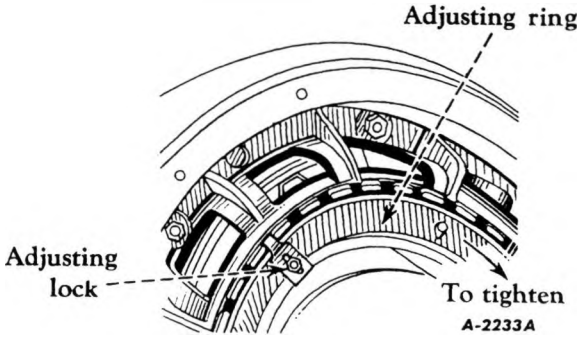
(2) Loosen the nut on the adjusting lock and disengage the lock from the notch in the back plate (Illust. 46).

(3) With the clutch hand lever in disengaged position, turn the adjusting ring clockwise direction one or two notches at a time. Check the progress of the adjustment each time by moving the hand lever forward. Continue to turn the adjusting ring until the overcenter engagement becomes very difficult. Then back off the adjusting ring one notch at a time until correct engagement is obtained.

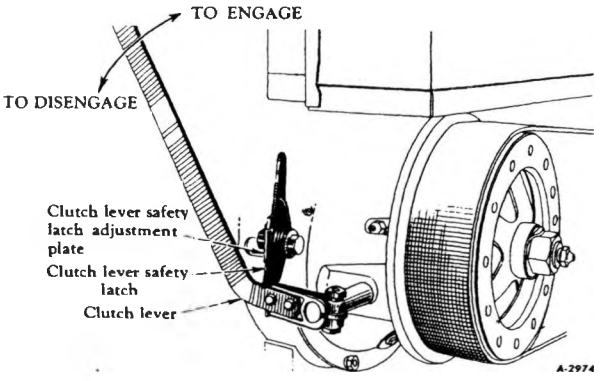
For satisfactory operation, do not have the clutch adjusted so tight that full engagement of hand lever is difficult to obtain.

(4) When the correct clutch adjustment is obtained be sure to engage the adjusting lock in notches on the back plate and tighten nut.

A 9-inch spring loaded, hand operated clutch and a 7-inch "Twin Disc" over-center, toggle type clutch are available for the U-2 power unit as special attachments. Complete information on removal and rebuilding these and regular production clutches will be found in Manual No. 10 of Blue Ribbon Service Training Course (form No.CHS-62).



Illust. 46. Adjustment of U-2 over-center clutch.

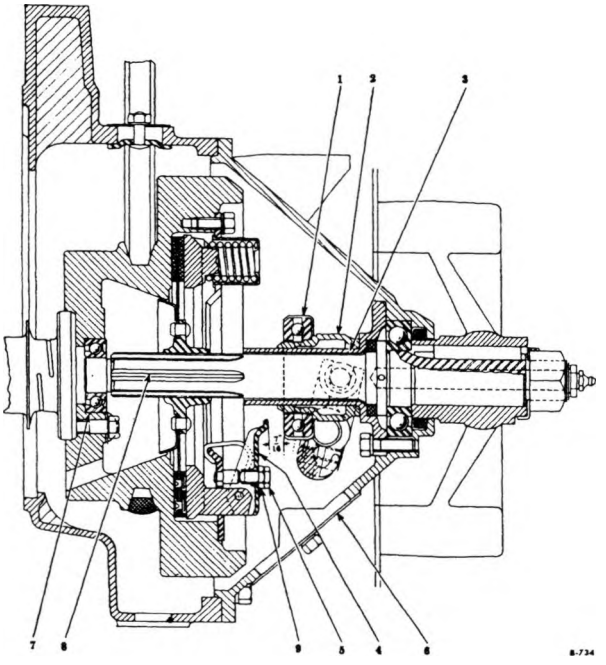


Illust. 47. Harvester-thresher engine clutch control.

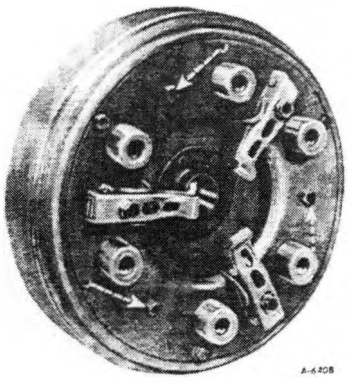
No. 22 Harvester-Thresher Engine

The engine attachment for the No. 22 harvester-thresher is equipped with an 8-inch spring-loaded, single plate, dry disc hand operated clutch. The clutch hand lever is provided with a safety latch to prevent accidental engagement of the clutch when it is locked out of engagement.

With the clutch hand lever held in the disengaged position, the tip of the



Illust. 48. Cross section of harvester-thresher engine flywheel and clutch showing (1) release bearing; (2) release sleeve; (3) release sleeve guide; (4) release lever; (5) adjusting screw; (6) handhole cover; (7) clutch pilot bearing; (8) clutch shaft spline; (9) adjusting screw nut.



Illust. 49. Spring loaded clutch showing three alternate cap screws in position for removing clutch from flywheel.

safety latch should clear the hand lever by 1/8 inch. This adjustment may be made by loosening the latch bolt and moving the latch assembly up or down (Illust. 49).

The clutch release levers and release bearing may be inspected through the hand hole opening in the clutch housing. The normal maximum clearance between the release bearing and the release levers should be 7/16-inch. As the friction surfaces wear this clearance will be reduced, at which time it is necessary to reset the release levers to recover the 7/16-inch clearance between each of the three release levers and the release bearing (Illust. 48). Be sure the release bearing sleeve is back against its stop when inspecting or adjusting the above clearance.

To remove the clutch unit from the flywheel it is necessary to remove the cap screws from the outer diameter of the clutch housing, and remove the housing, belt pulley and shaft as a complete unit. Remove three alternate cap screws from the outer diameter of the clutch back plate and insert them in the three holes provided for holding the clutch under compression, then remove the remaining three cap screws to remove the clutch assembly (Illust. 49).

To replace the clutch assembly follow the above instructions in the reverse order. Do not leave any of the cap screws used to hold the clutch under compression in the pressure plate when completing the assembly. For complete information on rebuilding clutch assembly refer to Manual No. 10 of Blue Ribbon Service Training Course (form CHS-62).

TRANSMISSION AND DIFFERENTIAL

Transmission

The transmission in Farmalls A and B series tractors is a selective sliding spur gear type having four speeds forward and one reverse. Gears are mounted on two shafts except for the reverse idler gear, which is mounted on a separate idler shaft.

The upper, or spline shaft revolves on two single-row ball bearings which are mounted direct in the transmission case. The power take-off shaft, when used, is attached to the rear of the spline shaft.

The lower, or countershaft revolves on a roller bearing located at the pinion end and a single row ball bearing at the opposite end of the shaft. This ball bearing takes the end thrust of the bevel pinion and is mounted in a bearing cage. Shims are provided between this bearing cage and the transmission case for adjustment of the bevel pinion to bevel gear.

Tractor traveling speeds in miles per hour, at rated full load governed engine speed (1400 r.p.m.), are given in the chart on the next page. Under light load the engine maximum ground speed is 5 to 10 percent faster than at full load, resulting in faster tractor traveling speeds. High and low profile tire treads affect the rolling radius of the rear wheels and result in slight differences in traveling speeds. Wheel slippage has not been considered in the chart on the following page.

The transmission gears, differential and drive bevel gears are enclosed in one case. Lubrication is by splash and distributed by channels cast in the case. To insure thorough lubrication when tractors are being used for belt work an oiler gear is mounted on the countershaft to mesh with the reverse spline gear. This oiler gear will be found on all tractors of this series except Farmalls A and B below serial number

TRANSMISSION AND DIFFERENTIAL

TRAVELING SPEEDS

Tractors	A, B, BN & Int. A		AV	
Tire size	8-24	9-24	8-36	9-36
Rolling radius, inches	18.1	19	24.1	25.1
First gear (ratio 68.299), mph	2.207	2.317	2.939	3.049
Second gear (ratio 43.049), mph	3.502	3.676	4.663	4.838
Third gear (ratio 32.690), mph	4.612	4.841	6.141	6.370
Fourth gear (ratio 15.752), mph	9.572	10.048	12.744	13.221
Reverse gear (ratio 54.639), mph	2.759	2.897	3.673	3.811

39022. For parts necessary to install this oiler gear in the earlier production A and B tractors see the following list:

New	Part	Replaced
8846 DA	Transmission case	8105 D
58337 D	First speed gear	49299 DB
58338 D	First speed gear spacer	.....
58339 D	Reverse idler shaft	43272 DB
61082 D	Reverse idler shaft lock screw	.....
58340 D	Transmission oiler gear	.....
	Power take-off shaft oil slinger (not required with new oiling system)	48093 D

The transmission case oil capacity is 1-1/2 gallons; spring loaded leather seals are used on the drive shaft and differential shafts to retain lubricant and seal out dirt. Lips of the oil seals face in.

Differential

The differential is a two-pinion open type. The bevel drive gear is riveted to a flange on the one-piece case. The unit revolves on two single-row ball bearings. Cages for these bearings are mounted in the transmission case. Shims are used between the bearing cages and the case to adjust end play of the unit and to obtain proper running clearance between the bevel drive gear and pinion. The differential shafts which carry the brake drums and final drive pinions are splined on their inner ends to fit inside the differential bevel gears.

Since the transmission and differential share the same case the removal and assembly will be covered together.

Service

Removal

Differential. To dismantle, drain the transmission case and remove the final drive and differential shaft housing assemblies by taking out the cap screws which secure the shaft housings to the transmission case. Take off the rear transmission cover or power take-off and/or belt pulley attachment. Remove the right and left differential bearing cages and their respective shims, marking or placing them so that they may be reassembled in the same positions. The differential assembly may now be removed from the transmission case. The differential pinion shaft is held in place with a lock pin or retainer screw. By removing the pinion shaft the differential pinions and bevel gears are readily removed from the case.

The bevel drive gear can best be removed when necessary by center punching and drilling the rivets from the drive gear side. Use a 3/8-inch drill, drilling only to the flange of the differential case. This frees the drive gear, and the rivet stubs may then be punched

out of the differential case flange. This removal procedure prevents possibility of distorting the flange of the differential case.

Transmission. To dismantle, it is necessary to disconnect the transmission case from the clutch housing. Drain the case, remove the clutch drive shaft and flex joint. Remove the top and rear covers, transmission drive flange, and spline shaft front bearing retainer. Before the spline shaft can be removed it is necessary to remove the pin which holds the reverse spline gear in position on the shaft. Then drive the shaft out through the gears toward the rear. The reverse idler shaft is removed by removing the lock screw (on older production units a plug retainer was used).

The reverse idler gear bushing is reamed to give between .002 and .004-inch clearance. Service bushings are reamed to proper size and if carefully installed will give the required clearance on the reverse idler shaft.

To remove the lower, or countershaft it is necessary to first remove the differential assembly. Remove the front bearing cap, bearing retainer cap screw, and washer. The countershaft may now be driven toward the rear through the gears. The front bearing cage and shims may also be removed from the case. Keep the shims for replacement in the same position upon assembly.

The transmission shift lever, shifter rails, poppet balls, and poppet springss are mounted in the transmission case cover. The shifter rails and poppet assemblies may be removed by spreading the four cap screw locks and removing the four 5/16-inch cap screws which secure the two shift rail guide brackets. The shift lever may be removed by driving out the swivel spring retainer pin and the shift swivel shaft. The shifter rail poppet notches should not be worn to allow the poppet balls excessive motion long-ways of the rail. The poppet springs may be compared with new stock for overall length and tension. Care should be taken in removing and replacing the transmission cover so that the shifter forks are not bent or sprung out of alignment, as this would result in only partial meshing of gears.

Assembly

The transmission countershaft (bevel pinion) must be assembled in the case before the upper spline shaft or the differential assembly can be mounted. Slide the countershaft into the case from the rear, mounting the gears in proper sequence. Mount the front bearing cage with the original shim pack as a starting point for adjustment. If the original shims are not available a trial shim pack may be made up of one each of the heavy and medium shims and six or eight assorted of the light and fine shims to give a total thickness of approximately .076 inch. Replace the bearing retainer washer, cap screw, bearing cap and cap screws. Pinion adjustment will be covered with the adjustment instructions for the differential bevel drive gear.

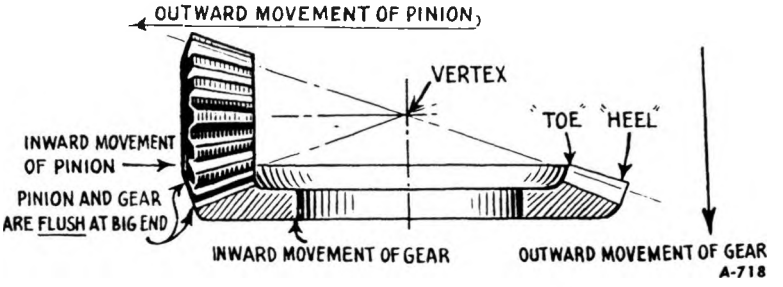
The differential assembly is made in the reverse order as given for removal. It is good practice to oil the differential pinions and bevel gears when mounting them in the case to prevent possible scoring before the transmission lubricant can get to them. Should it become necessary to remount the bevel gear on the differential case, care should be taken to firmly seat the gear on the case flange. It is best to attach the gear and case with three or four bolts, these bolts to be removed one by one as the rivets are pressed or driven.

The differential assembly may now be mounted in the transmission case. If the shims have not been disturbed, replace the same number in positions as removed. If the required amount of shimming is not known, attach the bearing cages without shims and tighten the right-hand cage until it is snug to the case. Tighten the left-hand cage until the assembly rotates freely without end play. The gap between the flange of the left cage and the transmission case indicates the amount of shimming required.

Divide up the shims with light, medium and heavy, using an equal number of each for each cage. Mount the cages and shims, tighten the cap screws and check the assembly again for free rotation or end play. Correct if necessary. Assuming the pinion is properly set for tooth bearing, shims can be taken from one cage and added to the other to obtain .005 to .007 inch backlash between the bevel gear and pinion measured at the close point of the bevel gear run-out.

Setting Bevel Gears

With the bevel pinion (transmission countershaft) assembled in the case with its trial shim pack and the differential assembly mounted in the case with shims in place to give .005 to .007-inch backlash between the bevel drive gear



Illust. 50. Pitch lines of bevel gears form cones which intersect at the vertex when properly adjusted.

and pinion, proceed to make the following test to determine proper setting of the gears. Always measure backlash at the close point of bevel gear run-out (Illust. 51).

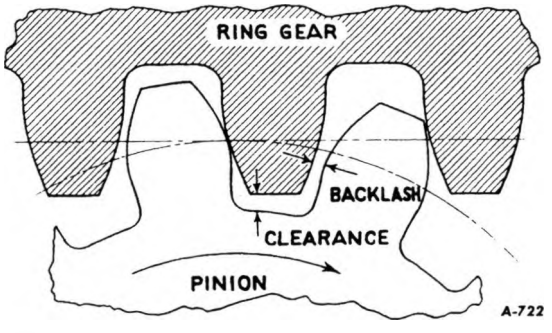
With this initial setting, paint the pinion teeth lightly with red lead or prussian blue and revolve the gears several revolutions in the forward travel direction so that paint will be removed from the "pull" side of the pinion teeth.

If the setting is correct the "pull" side of the pinion teeth will appear (Illust. 52). A similar tooth bearing will also appear on the bevel gear for both "reverse" and "pull" side of the teeth.

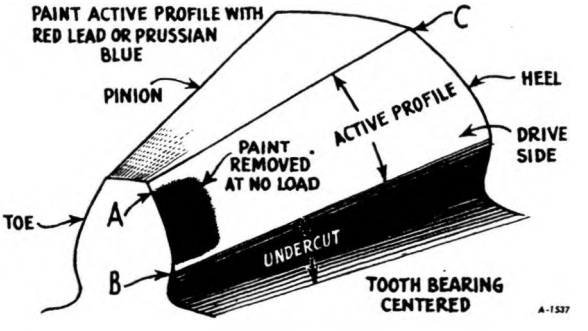
If paint is removed from the pinion indicating a high tooth bearing as in Illust. 53 this shows that the pinion is in too far and requires shims to be added to the pinion shim pack. Addition of shims to the pinion will increase the backlash between the gears and requires correction by moving shims from left side of differential to the right side.

Should paint be removed from the pinion, indicating a low tooth bearing as shown in Illust. 54, it shows that the pinion is too far out, requiring shims to be removed from the pinion shim pack. As this will reduce the backlash, correction must be made by moving shims from the right side of the differential to the left side to maintain the .005 to .007-inch backlash.

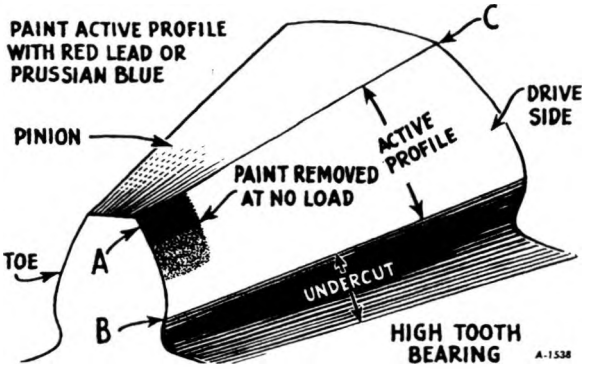
The tooth bearings shown in the three illustrations are the surfaces in contact at no load. Under load the bevel gear is deflected and assumes a slightly different position, resulting in a tooth bearing which extends from the toe to the heel of the tooth surfaces.



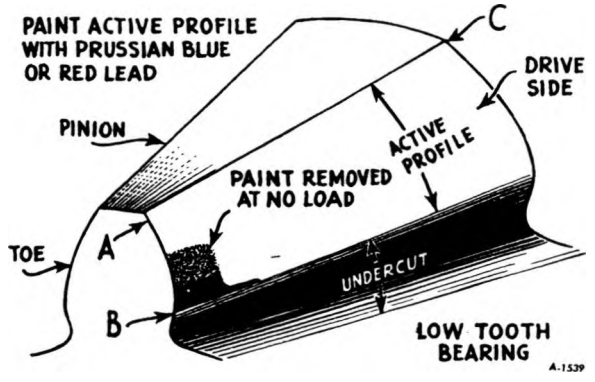
Illust. 51. The arrows indicate the back lash and clearance produced by adjusting the ring gear out-away from the pinion. The ring gear should have .005 to .007-inch backlash when the pinion is held stationary. To reduce the amount of backlash move the gear in, toward the pinion.



Illust. 52. Tooth bearing should be centered between "A" and "B" when gears are not under load. Gears should operate quietly with this type of tooth contact. Both pinion and gear should have similar tooth bearing when properly adjusted.



Illust. 53. High tooth bearing at "A" shows that the pinion has been set too far in (no load). To correct this bearing, remove the pinion out (arrow in Illust. 50) and then move ring gear in for proper backlash, if necessary.

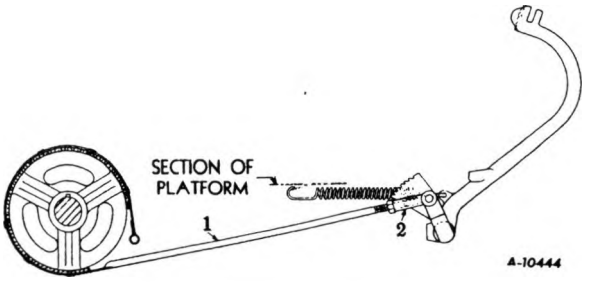


Illust. 54. Low tooth bearing at "B" shows that the pinion has been set too far out (no load). To correct this bearing, move the pinion in (arrow in Illust. 50) and then move ring gear out for proper backlash, if necessary.

BRAKES

The brakes consist of external contracting bands on forged steel drums mounted on the differential shafts in the housings. The brakes are operated by foot pedals which are operated either individually to aid in steering in field work or interlocked for road or high speed work. A ratchet pawl is raised by hand to lock the pedals and brakes in the applied position for parking.

The brake band lining is 1-3/4-inches wide by 18 inches long and is secured to the band with 12-1/4 x 5/32-inch countersunk head tubular rivets. The braking area is 31-1/2 square inches on each 6-3/4-inch drum.



Illust. 55. Diagram of foot brake in applied position.

Brake Adjustment

This is made by a threaded clevis on each brake rod. Change the length of the brake rod (1) by turning the clevis (2) until the pedal has about an inch of free movement at top (Illust. 55). Then equalize the brakes as follows: Jack up both rear wheels and block the tractor securely. Start the engine and shift into third or fourth speed. With the pedals locked together, application of the brakes should slow down both wheels and the engine at the same time. If, when the brakes are applied, one wheel stops and the other one continues to revolve, loosen the adjustment on the wheel that stops until both wheels slow down simultaneously when the brakes are applied.

Relining

To reline the bands it is necessary to remove the rear axle housing and differential shaft assemblies.

The brake drums are mounted on the differential shafts next to the transmission case on the left side and next to the rear axle housing on the right side of the tractor. Make the separation between the right rear axle housing and differential shaft housing on all tractors, on Farmalls A and AV and International A make the separation between the left rear axle housing, and on Farmalls B and BN between the left differential shaft housing and the transmission case, which gives free access to brake bands and drums. See Service Chart No. 7 of rear axle drive and differential.

FINAL DRIVE AND REAR AXLE

Description

The individual axle on each side of the tractor is driven from a pinion on the outer end of the differential shaft (Illust. 56). Axles, drive gears and pinion end of differential shafts are enclosed in the rear axle housings and run in a bath of oil. The oil capacity of the each final drive housings is 3 pints.

The differential shafts are splined on the inner end to engage the differential gears, the outer end of the differential shaft revolves in a single row ball bearing mounted in the rear axle housing. The drive pinion and shaft are made in one piece.

Axle shafts are mounted on two single-row ball bearings; the outer bearing, being held rigid in the housing by the bearing retainer, takes the axle thrust. The inner ends of the axles are splined to fit the splined hub of the bull gears. The bearings, spacers and bull gear are held in assembly on the axle shaft by spacer washers and cap screw on the inside end of the axle shaft. The pronged spacer on the inside end of the right axle engages the flats on the axle; this is used as a driving lug for seeding machine drives.

Removal of Differential Shaft

To remove the differential shaft, it is necessary to remove the rear axle housing complete. On Farmalls B and BN remove the differential shaft housing with the left rear axle housing. This exposes the brake drum, which is removed next. Then remove the differential shaft bearing cover. The shaft and bearing may now be driven out. A combination felt and leather seal is mounted in the rear axle housing contacting the differential shaft inside the pinion. The lip of the leather seal should face the pinion.

Removal of Axle Shaft

To remove the axle shaft, remove the inner bearing cap, the retaining cap screw and washers. Remove the outer bearing retainer cap screws and bottom oil pan.

The axle may now be driven out of the inner bearing and bull gear hub. A steel spacer washer will be found between the bull gear hub and the inner bearing. Care must be taken to see that this washer is in place upon reassembly of the axle. The rear axle combination felt and leather seal is contained in the outer bearing retainer. The lip of the leather seal is assembled toward the bearing. It is necessary to remove the axle to replace this seal. Chart No. 1 shows the differential, final drive and rear axles.

ELECTRICAL EQUIPMENT

Description

The electric starting and lighting attachments available for the Farmalls A and B series tractors and U-2 power units greatly extend their usefulness and flexibility. Any boy or girl who can drive a car can safely operate a starter-equipped machine. The use of electric lights extends the tractor's working day to 24 hours when necessary during the rush season.

With the increasing number of machines now being equipped with starter and lights, it is essential that servicemen should be thoroughly familiar with the electrical system.

Like most automotive electrical systems, one side of the electrical circuit of each unit is connected to a common "ground," which is the frame or metal

parts of the tractor. When working on any part of the electrical system where there is danger of contacting a live wire or terminal with the "ground," the battery ground cable should first be disconnected. Do not reconnect the battery ground cable until all other equipment has been connected. This procedure is good insurance against short circuits which may start fires or damage some of the electrical units.

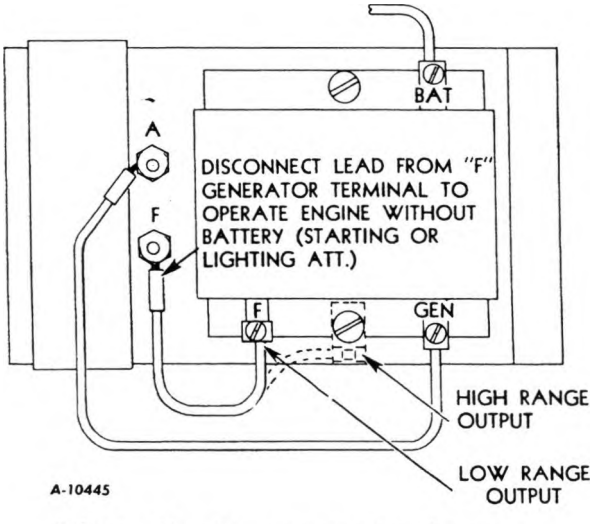
A large percentage of all electrical difficulties are caused by poor electrical connections in the circuit. Connections should not only be mechanically tight, but contacting surfaces must be clean to insure a good electrical connection.

Generator

SPECIFICATIONS

Make: Delco-Remy No. 1101355; IH No. 45634 D.
Drive..... V belt from fan hub
Rotation... Clockwise, viewing drive end
Brush spring tension, oz..... 14 to 18
Field current at 6v, amps.... 3.5 to 4.5
Output, maximum:
  Cold: 13 to 16 amp. at 7.7 to 8.1 volts at approx. 1800 rpm.
  Hot: 9 to 11 amp. at 7.3 to 7.6 volts at approx. 1900 rpm.
Cutout relay IH No. 46412 D:
  Point opening, in..... .020
  Points close, volts..... 6.75 to 7.5
  Points open.. 0 to 3.5 amp. discharge
  Armature spring tension, oz..... 6.2
Field circuit resistance unit (IH No. 47891 D): 2.8 ohms.

The generator provides electricity by mechanical action, supplying current for lights and restoring to the battery the current used in cranking. It is specially designed and dust-proofed to meet the demands of tractor operation.



Illust. 56. Generator wiring diagram.

A cutout relay, also dust-proofed, is mounted on the generator. The cutout relay is an automatic switch which connects the generator to the battery when the engine is operated and disconnects it when the engine stops and thus prevents the battery from discharging through the generator windings.

A fixed resistance unit for use in the generator field circuit is also enclosed by the dust-proofed relay cover.

The generator output can be regulated by changing the position of the third brush of the generator or by operating the combination light switch and generator output control. In addition, when the attachment does not include the lights and switch, the fixed resistance unit assembled in the cutout relay box is used.

The high range output is obtained by securing the lead from the "F" (field) terminal of the generator under the relay box mounting screw, as shown by the dotted line in Illust. 56. This permits the generator to produce full output as regulated by the position of its third brus brush.

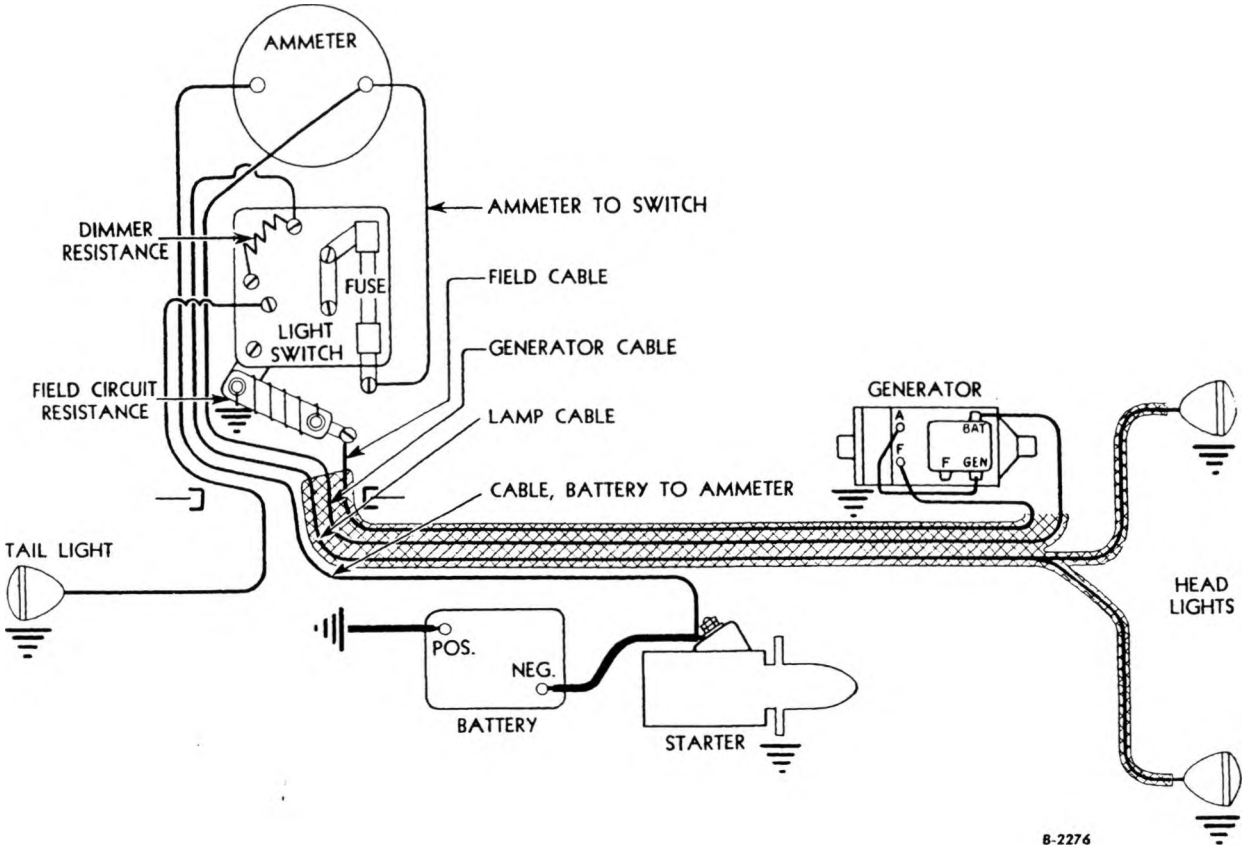
If the battery is in a charged condition it is preferable to operate with the "F" terminal lead connected to the resistance terminal "F" on the box so the generator produces a low range output (Illust. 56). This low output is approximately 4 amperes (generator hot) which is sufficient to replace in the battery the current used in starting and also provide a small charge so that the battery is kept in good condition without danger of overcharging.

Lighting Switch

SPECIFICATIONS

Make: Delco-Remy No. 1994019; IH No. 57310 DY.
Dimmer resistance, 5 ohms..... 47891 D
Generator field resistance, 2.8 ohms..... 47891 D
Lighting circuit fuse, 20 amp... 10815 V

The combination switch causes the generator output to increase when the lights are turned on so that the generator can supply the current necessary for the lights. When the lights are



Illust. 57. Electric starter and lights wiring diagram.

turned off, the generator output is reduced to protect the battery against overcharge.

There is also an intermediate position, "H," on the switch at which the lights are still off although the generator output is not reduced. This switch position permits a run-down battery to be brought up to charge.

The generator control is obtained by a fixed resistance unit mounted on the switch which is connected between the "F" generator terminal and ground when the lights are off (Illust. 57). The resistance being thus placed in the field circuit causes a weak generator field and a low generator output. When the lights are turned on or the switch is in "H" position the resistance is removed from the generator field circuit permitting the generator to produce full output, as regulated by the position of the generator third brush.

As a rule the position of the generator third brush need not be changed since it is originally set to give the maximum safe output. This is 9 to 11 amperes with the field resistance unit out of the circuit and the generator at operating temperatures. A cold generator will show a higher output, but this will lower several amperes as the generator warms up. A greater output than the above will cause the generator to overheat, resulting in damage to its windings and soldered connections.

To operate the tractor or power unit without a battery it is necessary to disconnect the lead from the "F" (field) terminal of the generator (Illust. 56). Removing the battery allows the generator to operate on an opened circuit, which will damage the generator windings if the field circuit is not also opened. Another method of protecting the generator when operating without the battery is to remove the generator drive belt; this is the better method if the unit is to be operated over long periods of time without a battery.

Failure of Generator Output

This may be caused by a number of conditions. The following check-up to locate the difficulty should be followed in the order given:

1. Connect a wire temporarily between

the "F" terminal of the generator and the generator frame, with the engine running at medium speed, being sure a good clean electrical contact is made. If the output comes up, the generator is in a normal condition, but the light switch and the switch wiring needs attention as it is not making a good electrical connection between the "F" generator terminal and the ground.

The metal frame of the light switch must make a good contact with the ground. Check the contact between the switch and the instrument box cover and between the instrument box and its support. All contacts must be clean and free from rust. See also that the resistance unit is in good condition, no wires broken and connections clean and tight. Remove the temporary wire after check is completed.

2. With the engine running a medium speed, use a short piece of wire connecting the GEN (generator) terminal of the relay with the BAT (battery) terminal of the relay leaving wires found on these terminals also connected. If the generator output comes up it indicates either the cutout relay is at fault or that the small amount of magnetism normally left in the generator was lost; this being restored by the battery current, no further attention is needed. Remove the wire jumper used to connect the relay terminals. Stop the engine. Restart the engine and, with relay cover removed, check the action of the relay. If defective, replace the relay.

3. Should the above checks fail to correct the difficulty, remove the generator cover band and inspect for thrown solder, commutator wear, roughness or high mica. Inspect the brushes for wear and the spring arms for tension. The brushes should contact the commutator firmly.

4. Inspect the inside of the cover band. If small particles of solder are found thrown from the commutator, it would indicate the generator has been overheated by too high an output or from running open circuited from the battery. This condition will require a complete test of the armature and windings and overhaul.

5. If the commutator looks black or dirty, use a strip of fine (No. 00) sandpaper, holding it against the commutator with a wood block while the generator is in operation. All dust from this operation must be blown out of the generator. NEVER use an emery-coated paper or cloth to clean the commutator, as emery embeds in the soft copper and will wear down the brushes rapidly. It also has a tendency to "short" across the commutator bars.

6. Should the commutator and brushes be gummed up with dirt and oil from excessive lubrication, it will prevent a good electrical contact of the brushes and the commutator will be found badly pitted. This condition calls for complete dismantling of the generator for thorough cleaning and turning down of the commutator.

7. In checking the connections between the generator and light switch, and from the generator, cutout relay, ammeter, and starter switch, to battery and its ground, do not be satsified with a tight connection alone. Be sure contact surfaces are also clean. A mechanically tight connection does not necessarily indicate a good electrical connection.

8. Inspect the generator and fan belt for wear or glazing from slipping and bottoming in the pulley. Replace belt if necessary. Check bearings for roughness or wear by turning the pulley by hand and testing for excessive side play.

Starting Motor

SPECIFICATIONS

Delco-Remy No..... 1107021
IH No..... 55784 D
Drive: Bendix LCD11FX-10; Delco-Remy No. 1868804.
Starting switch: Delco-Remy No. 1872405
Rotation: Counterclockwise, viewing drive end.
No-load: 65 amp., 5.0 volts, 5000 rpm.
Lock torque: 12 ft. lb., 525 amp., 3.37 volts.
Brush spring tension, oz.,..... 24 to 28

The electric starting motor is mounted in the left side of the flywheel housing. The starter switch is mounted directly on the starting motor and is operated by a rod which extends back within easy reach of the operator. The starter drive is Bendix type. The drive pinion meshes with the flywheel ring gear with the first few revolutions of the starting motor after the switch contacts are closed.

Failure of the starting motor may be caused by a number of conditions. each

of which can be readily located by making the following inspections:

1. Check the battery for condition of charge to determine if it can deliver sufficient current to crank the engine.

2. Inspect battery cables for condition and be sure all connections are clean and tight to insure good electrical contacts.

3. With battery ground cable removed, remove the starter switch and inspect for worn or burned contacts which would prevent the switch from closing the starter circuit.

4. Remove the starting motor cover band and inspect the commutator and brushes for wear. Check brush holders for freeness of movement on their pivots and spring tension to insure firm contact of brushes on commutator. Check the brush pigtail connections and brush retainer screws for tightness. Replace excessively worn brushes.

5. If the commutator is black or dirty, hold a piece of fine sandpaper (No. 00) against it with a piece of wood while the unit is operated. (Keep ignition off to prevent engine starting.) Blow out all dust. Never use an emery coated paper or cloth to clean commutator, as emery embeds in the soft copper and will cause brushes to wear rapidly.

6. Inspect the "Bendix" drive for dirt or oily gum which would cause the pinion to mesh slowly or not at all on starting. The Bendix drive is constructed to operate without lubrication on the threaded sleeve or pinion and should be washed clean of any oil or gum. The outboard bushing on the shaft is of self-lubricating type which does not require additional lubrication.

The large flat coil spring on the Bendix drive acts as a cushion as the pinion meshes the flywheel gear and also absorbs the shock of starting flywheel rotation. The pinion is driven through this spring and requires the spring to be in good condition; the retaining screws must be tight and their locks in place.

7. Inspect the starting motor shaft for excessive side play indicating worn bushings, which would allow the armature to drag on the field poles. The armature may turn free by hand but will drag when the starter switch is closed due to the pull of the magnetic field. Replace bushings if necessary.

The flywheel ring gear is a tight fit on the flywheel. When installing, it should be heated to approximately 500 degrees F.; care should be taken not to exceed this temperature. Do not heat the gear with a welding torch or by direct flame. Uncontrolled heat will destroy the temper of the gear.

Battery

SPECIFICATIONS

Autolite No. LB-1-13; IH No. 60909-D
Voltage..... 6
Number plates per cell..... 13
Capacity, amp.:
  At 20 hour discharge rate..... 80
  At 20 minute discharge rate..... 105
Electrolyte level above top of separators: 3/8-in.
Hydrometer readings at 80° F.:
  Fully charged..... 1.280
  One-half charged..... 1.220
  Discharged..... 1.150
Terminal grounded..... Positive
Battery box dimensions (max. inside), in.:
  9-1/16 x 7-3/16 x 8-21/32 high.

The battery supplies electricity by chemical action. It furnishes electricity for lights and for cranking the engine in starting. The battery is able to supply, for short periods of time, electricity for loads far in excess of the generator output.

The battery has a second function, that of "floating on the line," balancing or stabilizing the line voltage of the electrical system under normal operating conditions. If it were not for the battery, the voltage would rise and fall with the speed of the generator. Should the battery cables become loose or corroded, thus forming a poor electrical connection, the generator voltage could rise to a point where lamp filaments would be burned out, and the generator itself might fail because of overheating from the high voltage produced within its windings.

Water will be evaporated slowly from the electrolyte under normal operating temperatures of the battery. Rapid evaporation of water from the battery electrolyte would indicate that the battery is being overcharged, thereby increasing the operating temperatures above normal. In addition to rapid evaporation of water from the electrolyte, overcharging also causes excessive gassing. Bubbles of these gases, rushing upward, cause small particles of active material to break away from the plate grids. This

loss definitely shortens the life of the battery.

Neglect in keeping the battery electrolyte at the proper level will also shorten the battery life. A low electrolyte level will result in a higher concentration of acid, as only the water is evaporated from the solution. This strong acid chars the separators and shortens their life, and the partially exposed plate surfaces, being inactive, become badly sulphated.

Undercharging or storage in a partially charged condition permits sulphate to grow between the particles of active material, setting up unequal strains within the plate. This tends to buckle the plates. A badly buckled plate may cut or wear through a separator, thus short-circuiting the cell and rendering the battery inoperative.

In testing the battery with a hydrometer, a variation in reading between cells of 15 points is not considered abnormal. If the variation exceeds this amount the low reading cells should be considered defective.

Voltage tests of each cell should be made under normal starting motor load. The individual cell voltages should not fall below 1.5 volts per cell at 60° F. or above, if the hydrometer reading is 1.225 or higher. The variation between cell voltages should not exceed two-tenths of a volt. A greater differential in voltage between cells would indicate defective cells.

CHASSIS

Frame

The rear section contains the transmission and differential assembled in a one-piece gray iron case.

In the Farmalls A and AV and International A the left final drive housing is secured directly to the transmission-differential case by cap screws and dowels. Farmalls B and BN, because of the wider rear tread, have a longer differential shaft on the left side, enclosed in a gray iron casting mounted with cap screws and dowels between the final drive housing and the transmission-differential case, the same as on the right side on all models.

The transmission-differential case is connected to the engine crankcase casting by the clutch housing. Here again dowels are used to maintain positive alignment. The steering gear housing attaches to the front of the engine crankcase. This housing carries the front wheel fork on the Farmalls B and BN, and forms the mounting pivot for the front axle on the Farmalls A and AV and International A. Doweling and bolting together of all parts mentioned makes a rigid frame construction.

Front Axle

Farmalls B and BN. The single front wheel is mounted in a fork which is bolted directly to the steering worm wheel shaft. This steering worm wheel shaft carries the weight of the front end of the tractor and is mounted in two single-row ball bearings. Double front wheels are available as a special feature, a lower bolster replacing the fork.

Farmall A. The front axle is of welded tubular steel construction, the center of which is mounted on a pivot shaft in the steering gear housing base. Pivot shaft bushings are furnished reamed to size and require no reaming after assembly. Steering knuckle post bushings are also furnished reamed to size. Steering knuckle arms are attached to the steering gear arm by tie rods. At each end of the tie rods are adjustable ball joints.

Farmall-AV and International A. These are very similar in construction, the only difference being the length of the steering knuckle post and knuckle for the greater ground clearance of the Farmall-AV. The axle is of heavy duty, tubular cast malleable construction, the center of which is mounted on a pivot shaft in the steering gear housing base. The pivot shaft extends back from the steering gear housing base to the clutch housing, thus acting as a brace for the axle and steering assembly. The steering knuckle posts are adjustable in the axle center to obtain the adjustable tread of 2-inch steps. Bushings of the

pivot shaft and steering knuckles are furnished reamed to size. Steering knuckle arms are attached to the steering gear arm by tie rods having adjustable ball joints.

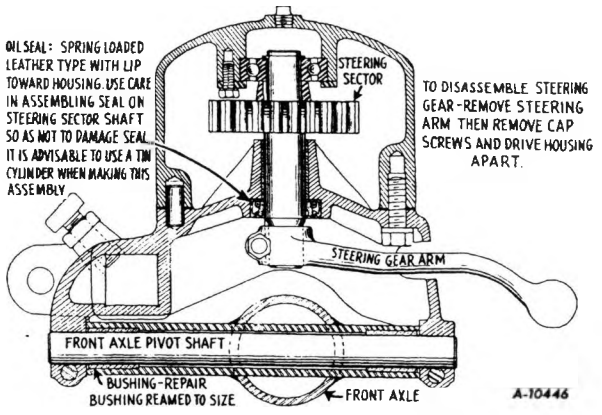
Steering Gear

Farmalls B and BN. The steering gear is identical on these two tractors. The steering wheel shaft and the steering worm shaft are connected by a universal joint. The worm shaft is mounted on a bushing at the rear with a single-row ball bearing at the front of the steering gear housing to take the worm thrust. The bushing is furnished reamed to size. The worm shaft is sealed with a spring-loaded leather seal at the rear of the housing. By disconnecting the universal joint from the worm shaft and removing the large bearing retainer plug the worm shaft may be removed from the front of the steering gear housing.

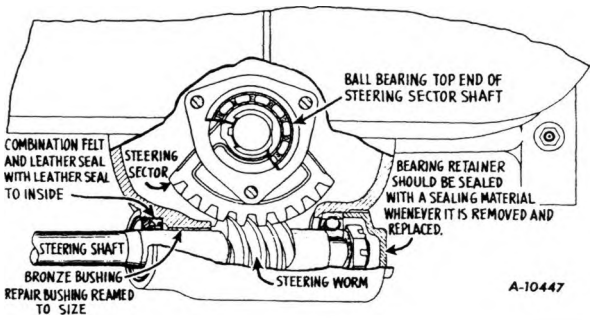
The steering worm wheel, shaft and bearing assembly may be removed from the steering gear housing by removing the cap screws in the lower bearing cage. Two single-row ball bearings are used on this shaft. The lower bearing cage is equipped with a spring loaded leather seal to retain lubricant and seal out dirt. The lip of this seal faces inward.

International A and Farmalls A and AV. These are identical. The steering worm shaft is in one piece extending from the steering gear housing to the steering wheel. The worm shaft is mounted on a bushing at the rear and a single-row ball bearing at the front of the steering gear housing to take the worm thrust (Illusts. 58 and 59). The bushing is furnished reamed to size. The worm shaft is sealed with a spring-loaded leather seal at the rear of the housing. The worm shaft is removed from the front of the housing after the removal of the large bearing retainer plug.

The steering worm wheel shaft and**** bearing assembly may be removed by removing the axle assembly and the steering gear housing base in which the axle pivots. The upper worm gear shaft bearing is a single-row ball bearing secured in the housing by a retainer and three cap screws and on the shaft by a snap ring. The lower bearing is a bushing furnished reamed to size. A spring loaded leather seal is used at the lower end of the worm wheel shaft to retain the lubricant and seal out dirt. The lip of the seal is faced inward. The steering gear housing bases and steering gear arms are somewhat different because


OIL SEAL: SPRING LOADED LEATHER TYPE WITH LIP TOWARD HOUSING. USE CARE IN ASSEMBLING SEAL ON STEERING SECTOR SHAFT SO AS NOT TO DAMAGE SEAL IT IS ADVISABLE TO USE A TIN CYLINDER WHEN MAKING THIS ASSEMBLY
STEERING SECTOR
TO DISASSEMBLE STEERING GEAR-REMOVE STEERING ARM THEN REMOVE CAP SCREWS AND DRIVE HOUSING APART.
STEERING GEAR ARM
FRONT AXLE PIVOT SHAFT
BUSHING-REPAIR BUSHING REAMED TO SIZE
FRONT AXLE
A-10446

Illust. 58. Cross section showing side view of Farmall-A steering gear.


BALL BEARING TOP END OF STEERING SECTOR SHAFT
COMBINATION FELT AND LEATHER SEAL WITH LEATHER SEAL TO INSIDE
STEERING SECTOR
BEARING RETAINER SHOULD BE SEALED WITH A SEALING MATERIAL WHENEVER IT IS REMOVED AND REPLACED.
STEERING SHAFT
BRONZE BUSHING REPAIR BUSHING REAMED TO SIZE
STEERING WORM
A-10447

Illust. 59. Cross section showing top of Farmall-A steering gear.

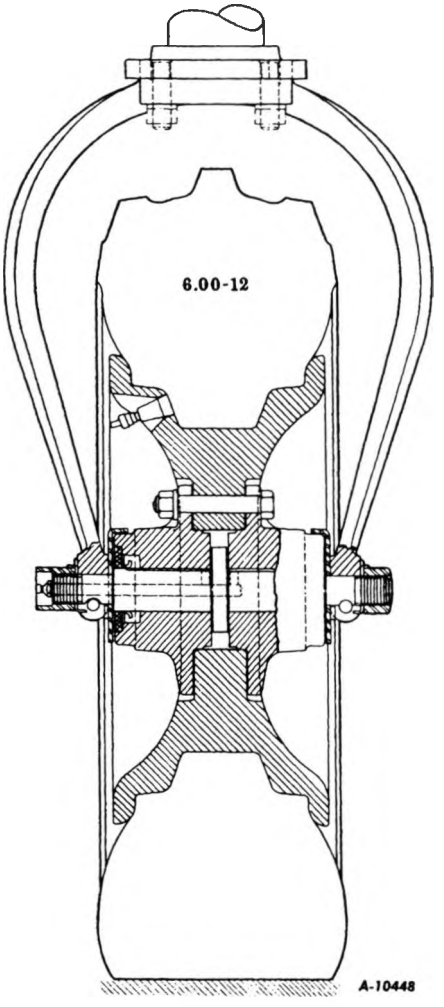
of the lighter type axle used on the Farmall-A.

Front Wheels

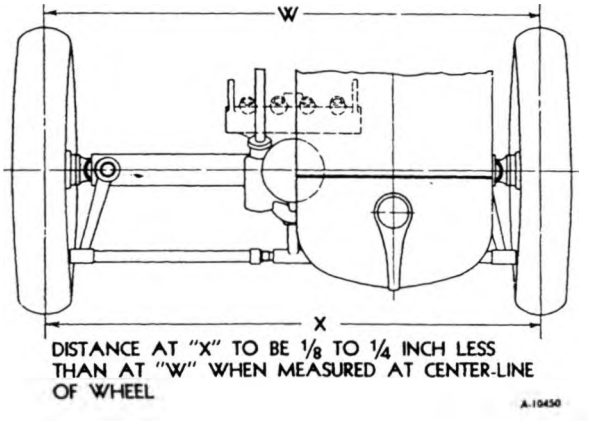
Farmalls B and BN. The single front wheel is a disc type (non-demountable) with integral drop center rim for 6.00 x 12-in. tire size. A single front wheel and fork for 7.50 x 10-in. size tire is also available. Plain bearings are used in both types of single front wheels, sealed at each end of the hub with spring loaded leather seals (Illust. 60).

Also available are double front wheels in either adjustable or non-adjustable tread types with demountable drop center rims, size 3.00D x 15. The double front wheels have tapered roller type bearings.

International A and Farmalls A and AV. These tractors have conventional type cast wheels with demountable drop center type rims. For the International A and Farmall-A the rim size is 3.00D x 15 and for the Farmall-AV it is 3.00D - 19. Tapered roller type bearings are used with seals and dust deflectors at the inner end of the hubs (Illust. 61).

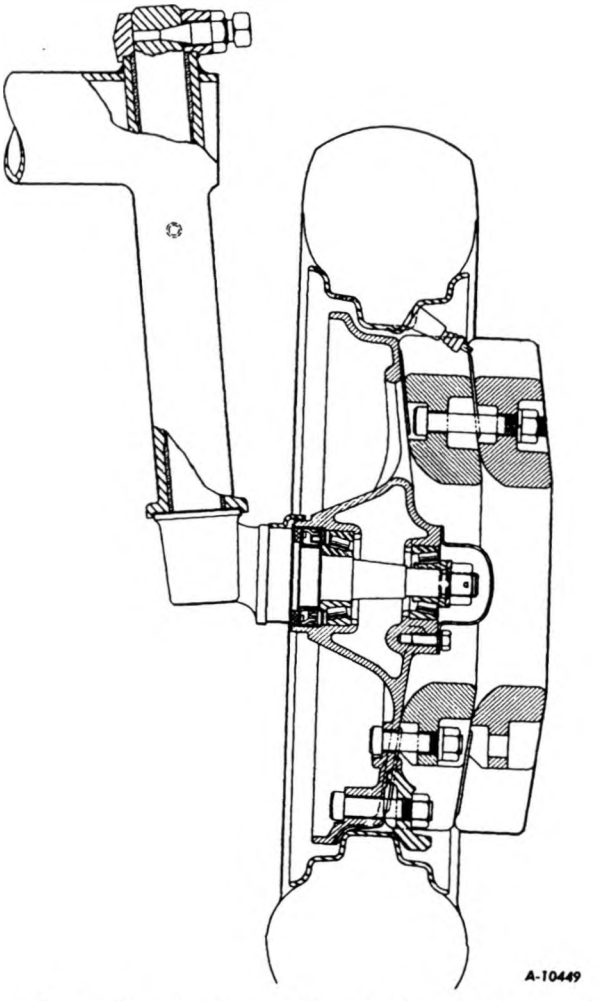


Illust. 60. Cross section of Farmall-B and BN single front wheel.



Illust. 62. Toe-in of Farmall-A and AV and International A front wheels.

Toe-in of the front wheel alignment should be 1/8 to 1/4-inch. This is measured from tire tread centers at hub height in front and behind axle (Illust. 62). Adjustment is secured by changing the length of the tie rods at the threaded end.



Illust. 61. Cross section of Farmall-A and AV and International A front wheels, with wheel weights.

Rear Wheels

International A and Farmall A. On these tractors the rear wheels are identical. A heavy cast disc type wheel is used on the right hand side and a pressed steel disc type is used on the left hand side. Each wheel is mounted on the axle flange with six special cap screws, and may be mounted with either convex or concave side out to obtain, with the different rim positions, the various wheel treads. Wheels are provided with mounting holes for the addition of cast wheel weights.

Rims are demountable, drop center type and may be mounted on the wheel in four positions to obtain, with the different wheel positions, the various wheel treads. Available rim and tire sizes are listed in the following section on pneumatic tires.

Farmall-AV. These are of cast disc type. The wheels mount on the axle

flange with six special cap screws and, like the Farmall-A, may be mounted with the convex or concave side out to obtain, with the different rim positions, the various wheel treads. The wheels are also provided with mounting holes for the addition of cast wheel weights. The rims are demountable, drop center type, and may be mounted on the wheel in three positions to obtain, with the different wheel positions, the various wheel treads.

Farmalls B and BN. These are identical. A pressed steel disc type is used, mounting on the axle flanges in the same manner as other models of the line. A heavy cast disc type wheel is also available. Both the cast type and the pressed steel type may be mounted with the convex or concave side out to obtain the various wheel treads; both are provided with mounting holes for the addition of cast wheel weights. The rims are of demountable, drop center type and may be mounted in four positions on the wheel to obtain, with the different wheel positions, the various wheel treads.

Care of Tires

The high inflation pressures used in tires during shipment of tractors must be reduced to normal operating pressures before tractors are removed from the freight car. Refer to the Owner's Manual for correct operating pressures. Operation of a tractor when tires are overinflated may result in serious damage to the casings even while driving the tractor from the freight car to the warehouse.

The tread bars on tractor tires wear evenly at proper air pressure and with the correct amount of wheel weight. Excessive slippage caused by insufficient wheel weight, overinflation, quick starting or too heavy draft load results in

Pneumatic Tires

Rim Size	Tire Size	A	Int. A	AV	B	BN	Notes
Front Tires - Single and Double:							
Single front wheel	7.50 x 10				x	x	Special fork & wheel
	6.00 x 12				x	x	
3.00D x 15	4.00 x 15	x	x		x	x	
3.00D x 15	5.00 x 15	x	x		#	#	#Not for adjustable tread
3.00D x 19	4.00 x 19			x			
Rear Tires - Single:							
5.50 R-24	7.00-24	x			x	x	Agricultural tread
W7 - 24	8 - 24	x	x		x	x	Agr. or Ind. tread
W8 - 24	9 - 24	x	x		x	x	Agr. or Ind. tread
W9 - 24	10 - 24	x	x		x	x	Agr. or Ind. tread
W10 - 24	11 - 24	x			x	x	Agricultural tread
W7 - 36	8 - 36			x			Agricultural tread
W8 - 36	9 - 36			x			Agricultural tread
Rear Tires - Dual (Special feature):							
W - 3 - 30	4 - 30	x			x	x	Agricultural tread
W - 4 - 30	5 - 30	x			x	x	Agricultural tread

an irregular angular wear on the front, or leading edges of the tread bars. Irregular and angular wear at the rear edges of the tread bars is caused by excessive wheel load, underinflation, or the combination of these two in highway or hard surface operation.

Frequent checking of air pressure with an accurate low-pressure gauge is the most important preventive maintenance operation. After mounting a new or old tire on the rim, inflate it to 30 pounds pressure to seat the tire bead against the rim flange. This prevents the tire from creeping or damaging the tube. Then deflate tire to the correct operating pressure. Be sure all rim clamps are properly assembled and clamp bolts are uniformly drawn up tight.

Liquid Weight

Tractor tire tubes can be filled with liquid to give the added rear wheel weight necessary to prevent excessive slippage under normal drawbar loads. Clean water may be used where temperatures are above freezing (32° F.). In climates where lower temperatures are encountered, a calcium chloride solution is recommended.

Various methods are used in filling tire tubes with liquid. They may be filled by gravity flow, by air pressure, or with a force pump. Instructions for mixing the solution and filling the tubes have been issued by the various tire manufacturers and are available to all dealers.

ATTACHMENTS

U-2 POWER UNIT ATTACHMENTS AND SPECIAL FEATURES

Automatic oil pressure and water temperature cut-out. . 57940 D

Belt tightener (for use with slide rails) . . . . . 62500 D
Belt pulley:
8½" diameter x 6-3/4" face. . 55224 DA
10" diameter x 6-3/4" face. . 66152 D

Clutch, 9-inch, spring-loaded . 57722 D

Direct connection (to flywheel) stub shaft . . . . . 57463 D
Distillate or kerosene:
Units having radiator 51149 D 60724 D
Units having radiator 51149 D 60725 D
Units on "M" Baling Press . . 64307 D

Electric starting . . . . . 60116 D
Units having radiator shutter or automatic cut-out . . . . 60117 D
Exhaust muffler . . . . . 48831 D

Fuel pump . . . . . 57326 D

Gas and gasoline attachment (combination). . . . . 57856 D
Gas attachment (straight) . . . 61385 D
Gear reduction attachments:
Engine rotation (2.56 to 1) . 62010 D
Engine rotation (3.60 to 1) . 62011 D
Engine rotation (4.90 to 1) . 62012 D
Anti-engine rotation (2.50 to 1). . . . . 62013 D
Anti-engine rotation (3.90 to 1). . . . . 62014 D

Governor speed change 1200 rpm. (5% variation). . . . . 57547 D

Hood side door attachments, 4 types, dependent upon equipment . . . . . .

Low boiling point thermostat (130 - 155) & heat indicator. . . . . 64074 D

Piston & sleeve assemblies:
8000-foot altitude (gasoline engine). . . . . 51188 D
8000-foot altitude (distillate or kerosene engine) . . 53078 D
5000-foot altitude (gasoline engine). . . . . 51189 D
5000-foot altitude (distillate or kerosene engine) . . 53077 D
Power take-off (Twin Disc). . . 62009 D

Radiator shutter, 5 types, dependent upon equipment . . .

Slide rails . . . . . 61553 D

Top cylinder oiler (Marvel) . . 57781 D
Transmission (four-speed), use with 57722 D clutch. . . . . 61024 D

water pump. . . . . 66752 D

ATTACHMENTS

TRACTOR ATTACHMENTS AND SPECIAL FEATURES

Description	A	AV	B	BN	Int. A
Adjustable front axle	48290 DA	.....	.....	.....	.....
Adjustable front axle, heavy duty	70335 D	.....	.....	.....	.....
Air pipe extension	63258 D	63258 D	63258 D	63258 D	63258 D
Adjustable front wheel (use with double front wheel or adjustable front axle)	57098 DA	.....	57098 DA	57098 DA	57098 DA
Adjustable double front wheel (to replace single front wheel)	.....	.....	.....	.....	.....
Collector precleaner	59206 DA	59206 DA	59206 DA	59206 DA	59206 DA
Dual rear wheel rims:					
W3-30 rim	58587 D	.....	58587 D	58587 D	.....
W4-30 rim	58588 D	.....	58588 D	58588 D	.....
Double front wheel	.....	.....	55460 D	55460 D	.....
Distillate or kerosene burning	*50619 D	.....	*50619 D	.....	.....
Exhaust muffler	48831 D	48831 D	48831 D	48831 D	48831 D
Front wheel weights:					
First set for double front wheels	48600 D	48600 D	48600 D	48600 D	48600 D
Second set for double front wheels	48602 D	48602 D	48602 D	48602 D	48602 D
Heavy rear wheel	.....	.....	56106 DA	56106 DA	.....
Heat indicator	61340 D	61340 D	61340 D	61340 D	61340 D
Pneumatic tire pump 39604 D or 39622 D	x	x	x	x	x
Radiator shutter	51419 D	51419 D	51419 D	51419 D	51419 D
Rear wheel weights:					
First set	54142 D	61719 D	50476 D	50476 D	54142 D
Second set	54143 D	49330 D	50477 D	50477 D	54143 D
Third set	.....	59331 D	.....	.....	.....
Spark arrester	55348 D	55348 D	55348 D	55348 D	55348 D
Swinging drawbar	43919 DA	57892 D	52989 DA	58849 D	43919 DA
Single front wheels:					
6.00 x 12 tire (regular)	.....	.....	58282 D	58282 D	.....
7.50 x 10 tire	.....	.....	57894 D	57894 D	.....
Piston and sleeve sets:					
5000-foot altitude, gasoline	51189 D	51189 D	51189 D	51189 D	51189 D
5000-foot altitude, kerosene	53077 D	53077 D	53077 D	53077 D	53077 D
8000-foot altitude, gasoline	51188 D	51188 D	51188 D	51188 D	51188 D
8000-foot altitude, kerosene	53078 D	53078 D	53078 D	53078 D	53078 D
Pneumatic Lift-All					
Gasoline tractor	15263EDX	15263EDX	15263EDX	15263EDX	15263EDX
Distillate-kerosene tractor	15264EDX	15264EDX	15264EDX	15264EDX	15264EDX

* Below FAA-41330 (Farmall-A) and FAB-40193 (Farmall-B).
** FAA-41330 (Farmall-A) and FAB-40193 (Farmall-B) and up.

Belt Pulley and Power Take Off

Tractors having the early non-standardized power take-off attachments with the 1-1/8 inch spline may be converted to the standardized power take-off by installing 66191-D conversion package, consisting of a 1-3/8" power take-off spline shaft and a drawbar extension plate.

The belt pulley and power take-off are both gear driven from the power take-off drive shaft (Illust. 63). This drive shaft is connected to the transmission upper or spline shaft by a jaw clutch controlled by a hand shift lever located to the left side of the operator's seat.

The rear end of the power take-off drive shaft revolves on a single row ball bearing. The front end is supported by a pilot bushing in the transmission spline shaft. The power take-off shaft revolves on two single row ball bearings. A double leather oil seal on this shaft prevents oil leakage and entrance of dirt. The lips of this seal face inward.

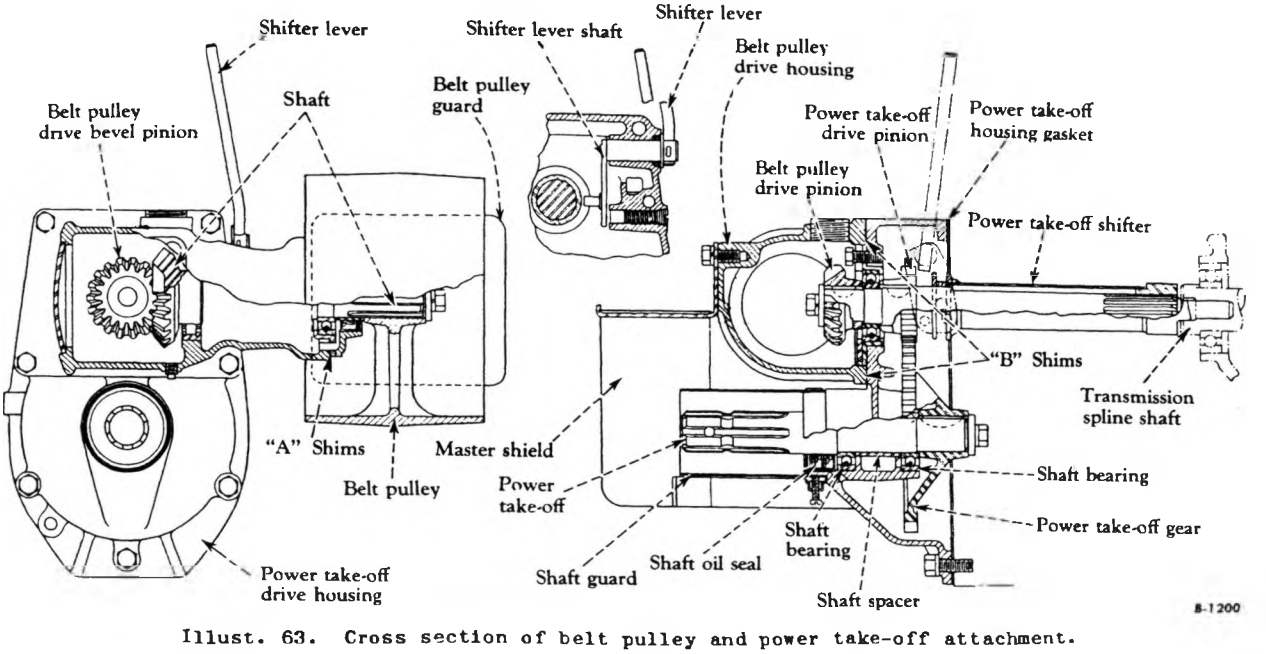
The belt pulley shaft revolves on one roller bearing at the bevel gear end and a single row ball bbearing takes the thrust at the opposite end of the shaft. This ball bearing is mounted in a cage. Shims are used between the cage and housing "A" (Illust. 63) to adjust bevel gear to pinion. A leather oil seal is mounted in this cage with lips facing inward. The adjustment of the bevel pinion to bevel gear is accomplished by shims placed between the belt pulley housing and the power take-off housing, "B" (Illust. 63).

On early production attachments (48153 D & 48104 D) the bevel pinion to bevel gear adjustment was obtained by use of shims between the rear power take-off drive shaft bearing cage and the belt pulley housing in which the cage was then mounted. On these early production power take-off attachments an oil slinger was used on the front end of the power take-off shaft to assist in circulation of lubricant.

Normal lubrication of the belt pulley and/or power take-off attachment is supplied from the transmission. However, when first installed it is good practice to place 1 pint of lubricant in the belt pulley housing. This is insurance against possible damage before belt pulley housing could receive lubrication from circulation of lubricant from transmission.

OPTIONAL BELT PULLEYS

Diameter Inches	Face Width Inches	Belt Speed Feet Per Minute
6½	6½	1968
7½	6½	2271
9½	6½	2876
10½	6½	3179



Illust. 63. Cross section of belt pulley and power take-off attachment.

ATTACHMENTS

SPECIFICATIONS

Power Take-Off Shaft

R.P.M.	541
Rotation, viewed from rear	Clockwise
Diameter, standardized p.t.o. shaft, in.	1-3/8
Diameter, non-standardized p.t.o. shaft, in.	1-1/8

Belt Pulley Shaft

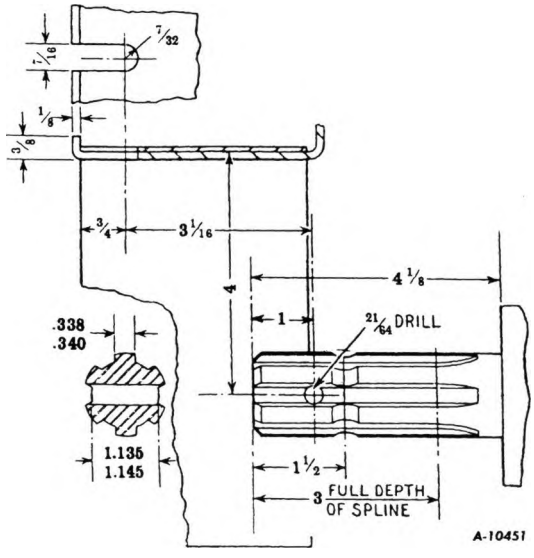
R.P.M. (governed rated load)	1156
Rotation, viewed from right	Counterclockwise
Pulley diameter, in.	8-1/2
Pulley face width, in.	6
Belt speed, feet per minute	2573

BELT PULLEY AND STANDARDIZED POWER TAKE-OFF ATTACHMENTS - ALL TRACTORS

	Numbered 501 to 39021 or having Transmission Case 8105 D	Numbered 39022 and up or having Transmission Case 8846 D
Belt pulley and power take-off attachment	66186 D	66188 D
Power take-off attachment only	66187 D	66189 D
Belt pulley attachment only	.....	60602 D
Power take-off for tractors equipped with belt pulley only	.....	66190 D**
Belt pulley for tractors equipped with power take-off only	56082 D	60604 D**

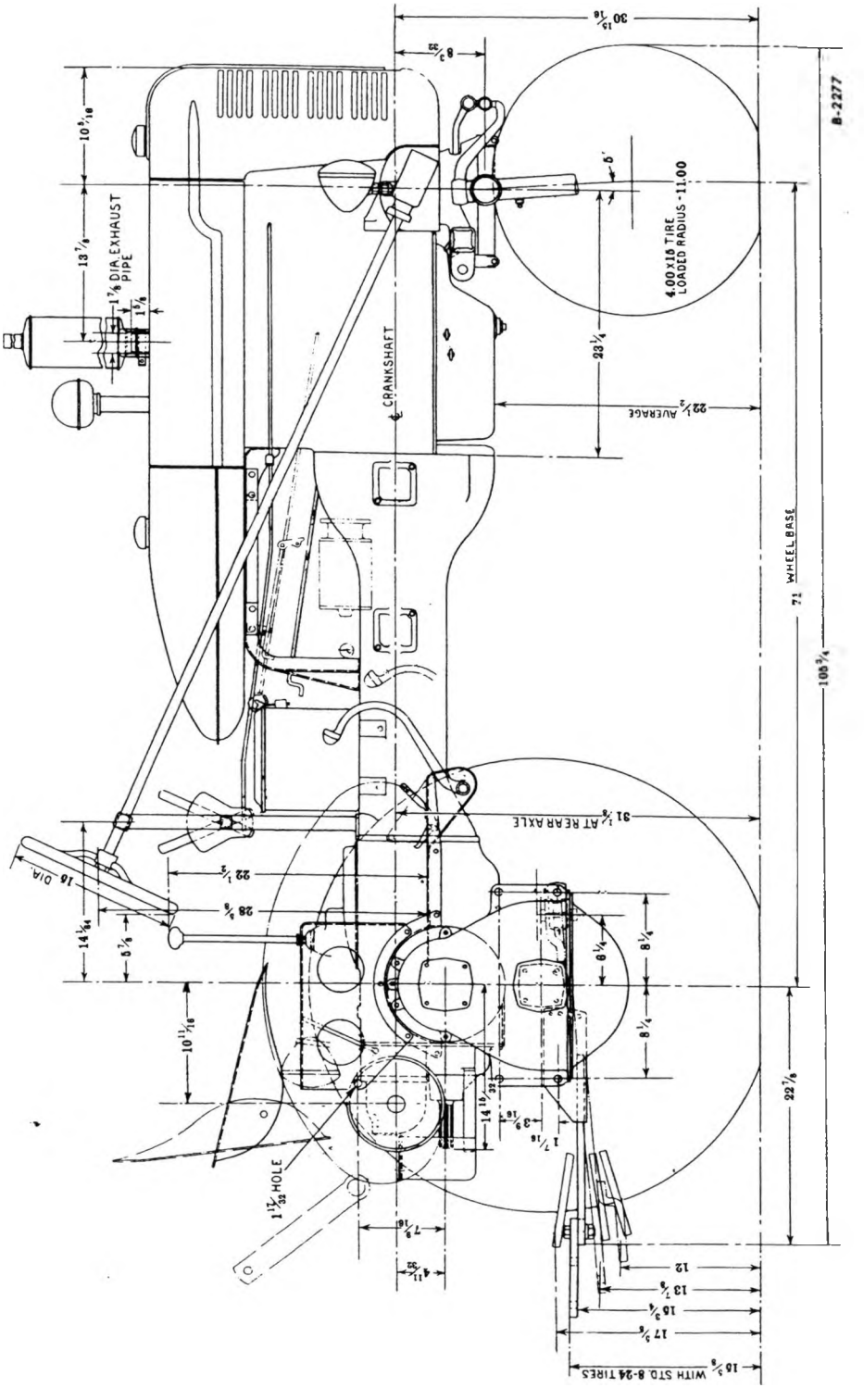
* Belt pulley attachment 56082 D for addition to tractors having power take-off attachment 66187 D or 48153 DA where PTO drive housing 6615 D was used.

** Attachments 66190 D and 60604 D for addition to tractors having attachments 60602 D, 66189 D, 60601 D or where PTO drive housing 9091 D was used.



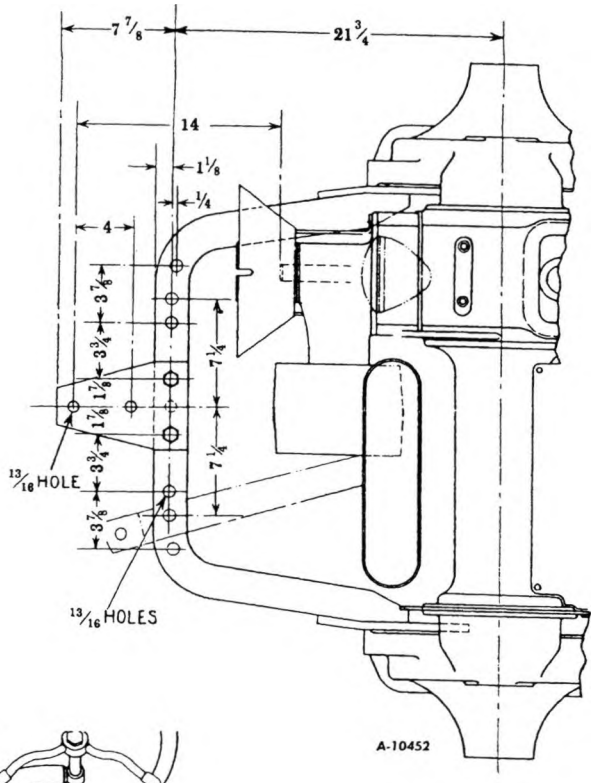
Illust. 64. Dimensions of power take-off shaft and shield.

DIMENSIONAL DRAWINGS

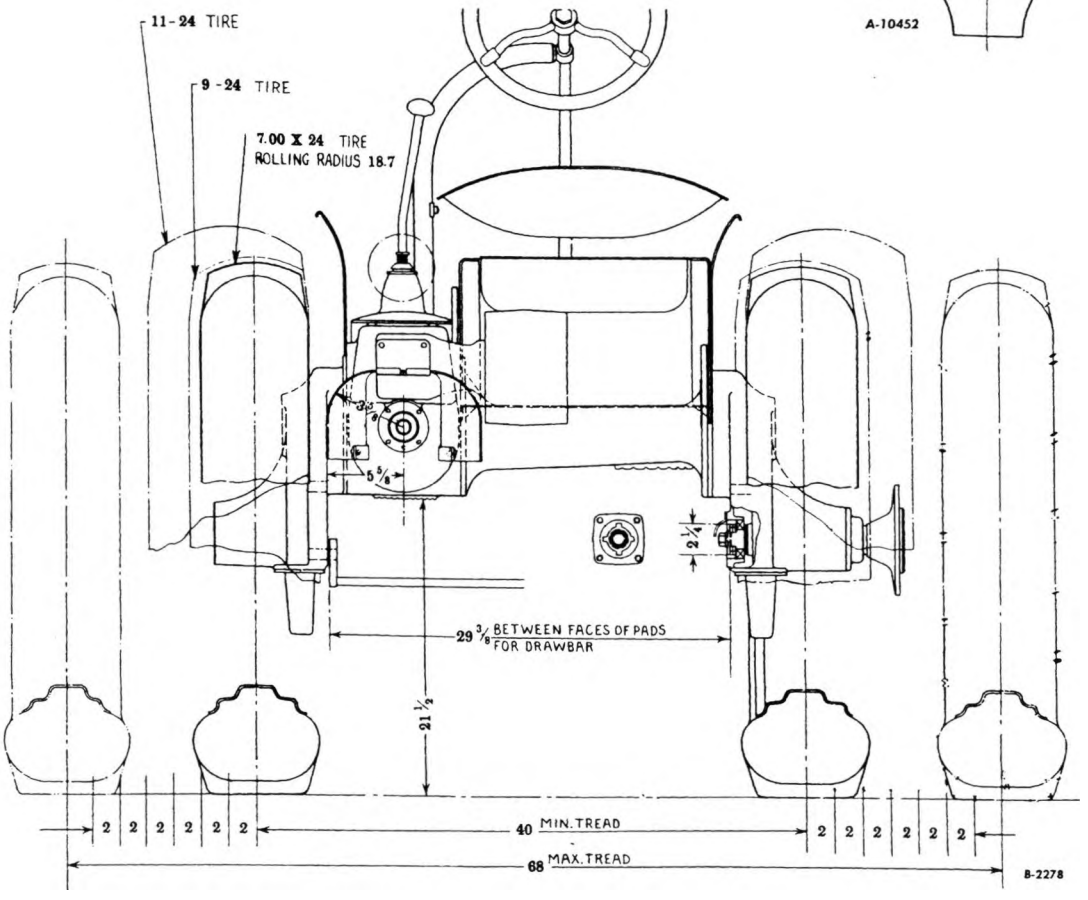


Illust. 65. Side view of Farmall-A, showing dimensions.

DIMENSIONAL DRAWINGS

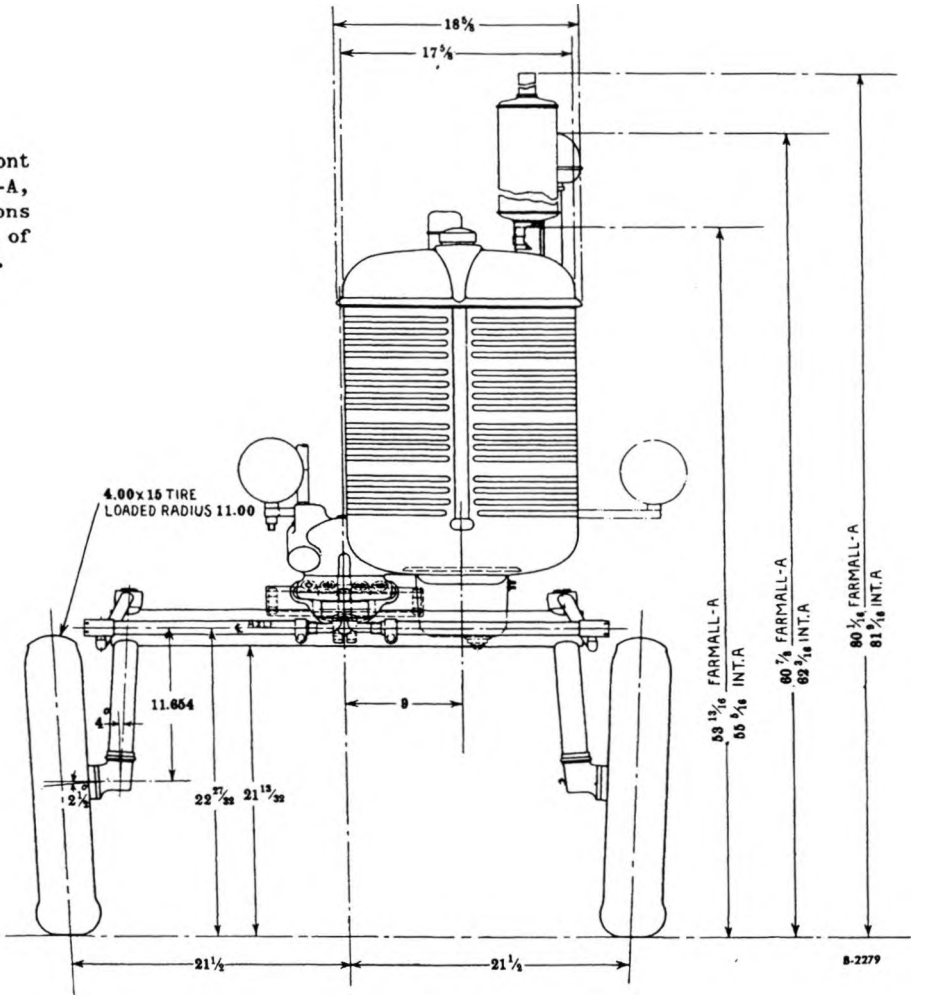


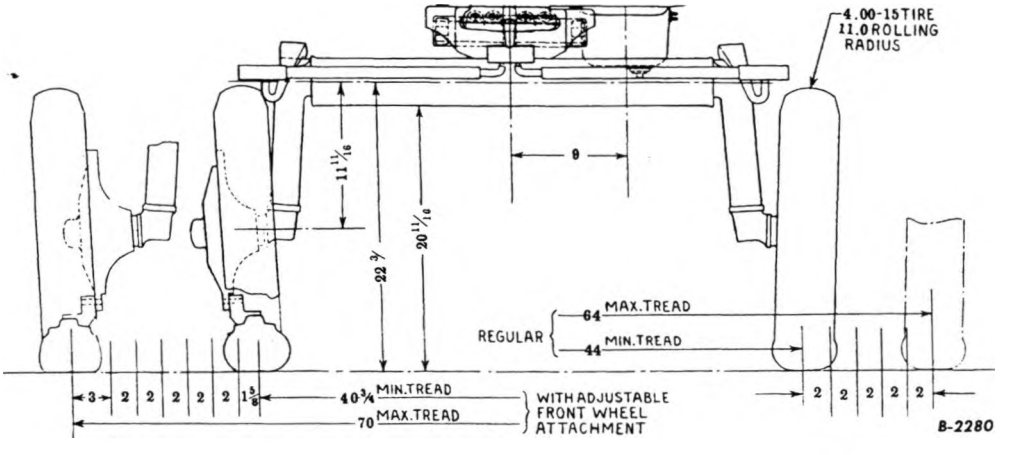
Illust. 66. Farmall-A drawbar dimensions.



Illust. 67. Rear view of Farmall-A, showing dimensions.

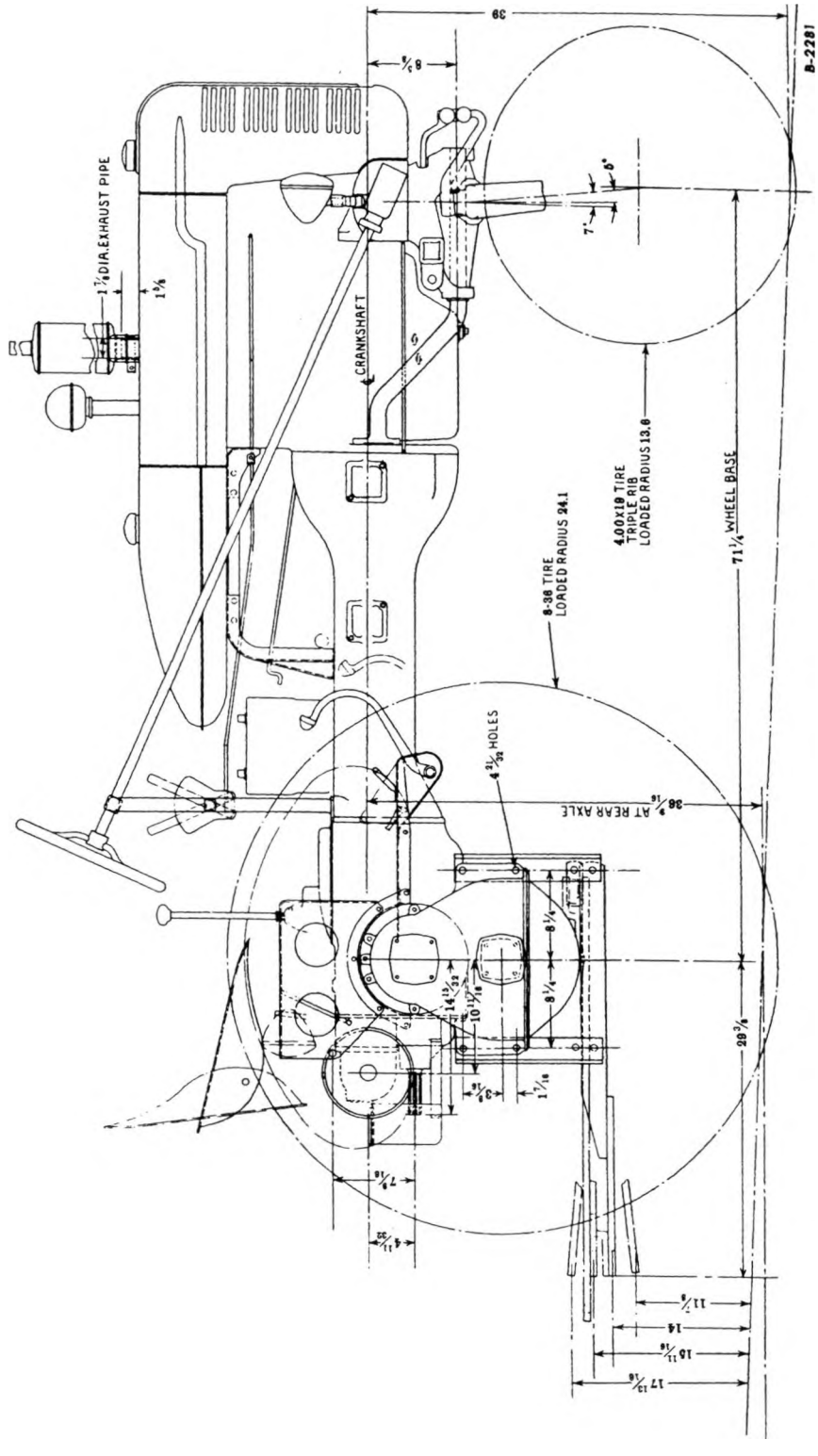
Illust. 68. Front view of Farmall-A, showing dimensions and dimensions of International A.



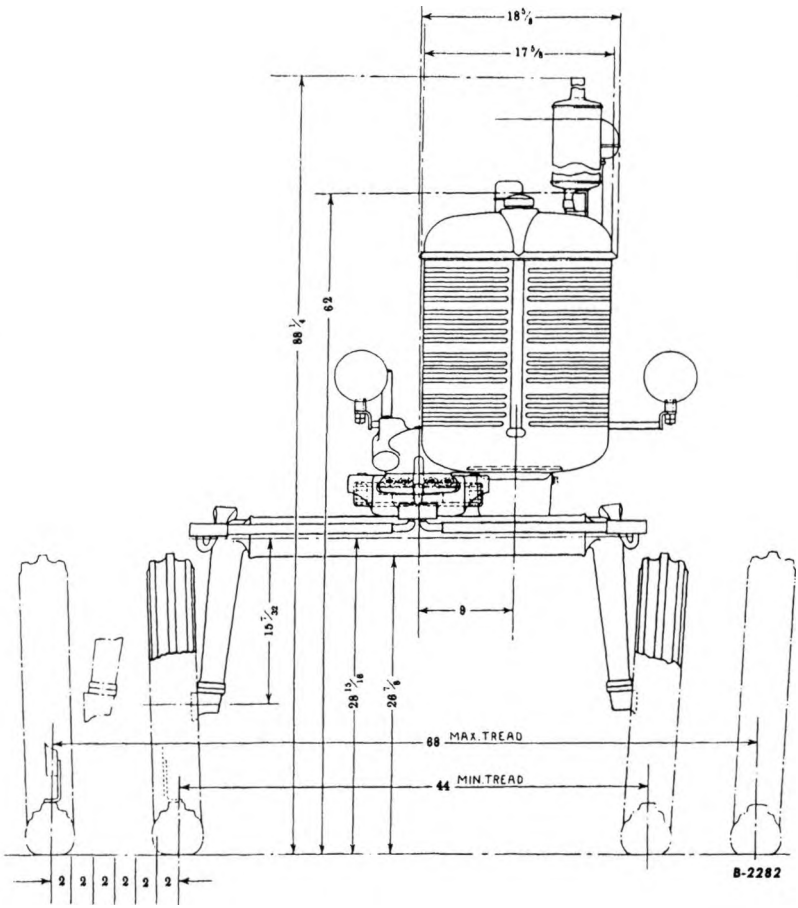


Illust. 69. Front view of International A, showing dimensions.

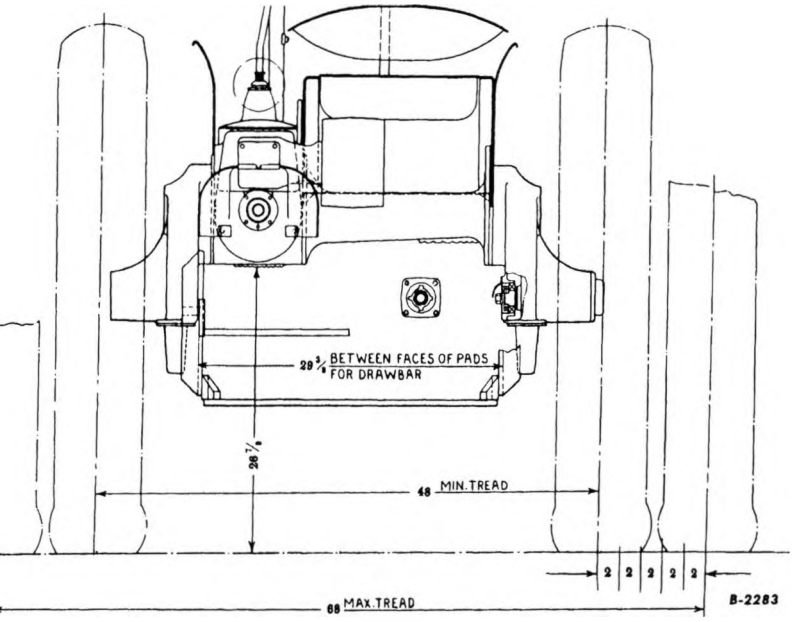
DIMENSIONAL DRAWINGS



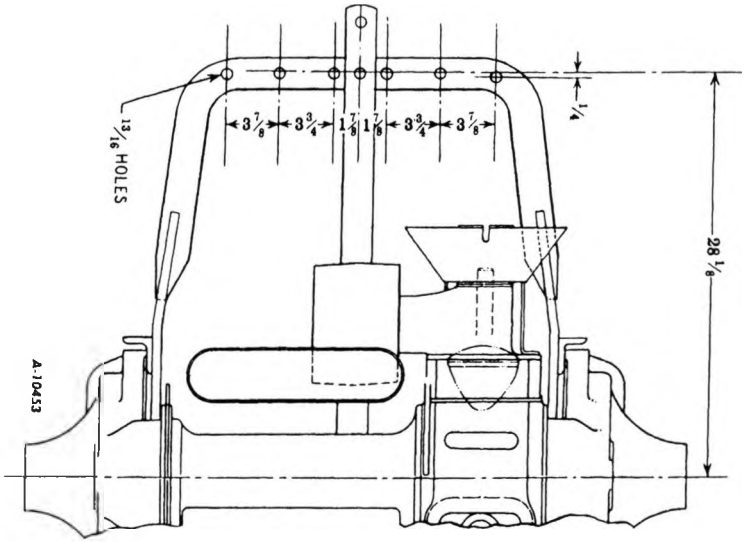
Illust. 70. Side view of Farmall-AV, showing dimensions.



Illust. 71. Front view of Farmall-AV, showing dimensions.

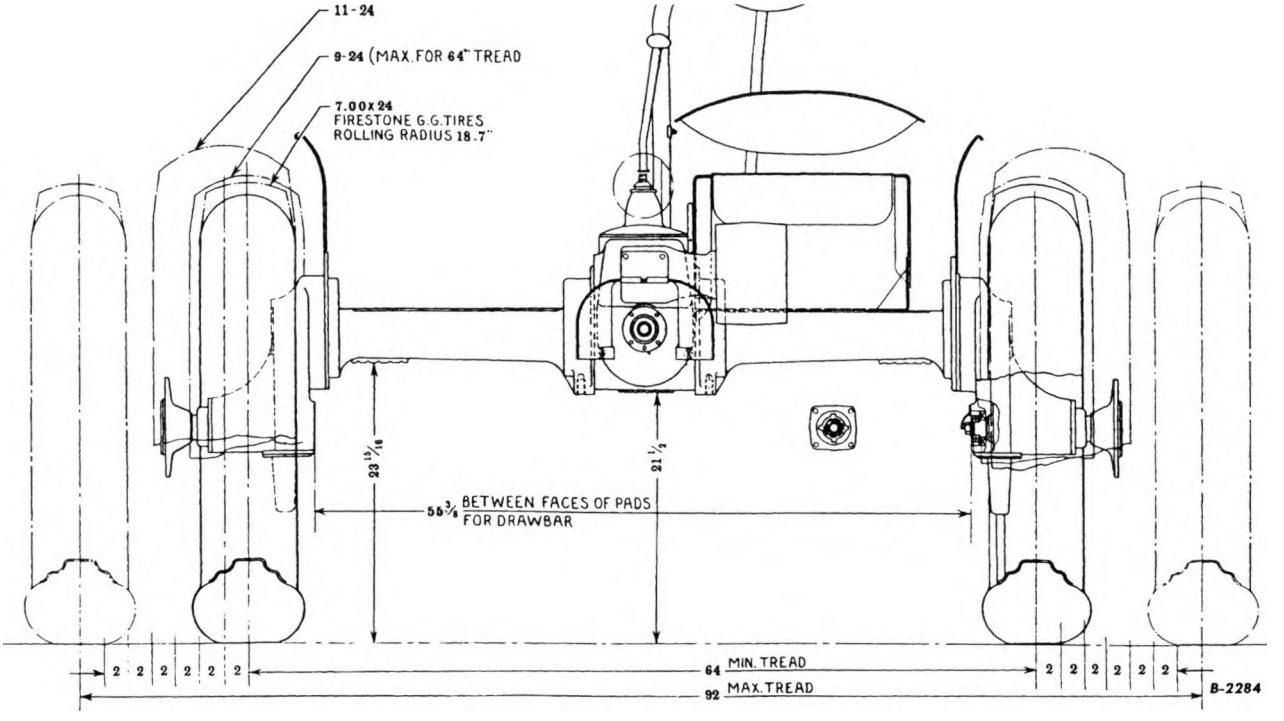


Illust. 72. Rear view of Farmall-AV, showing dimensions.

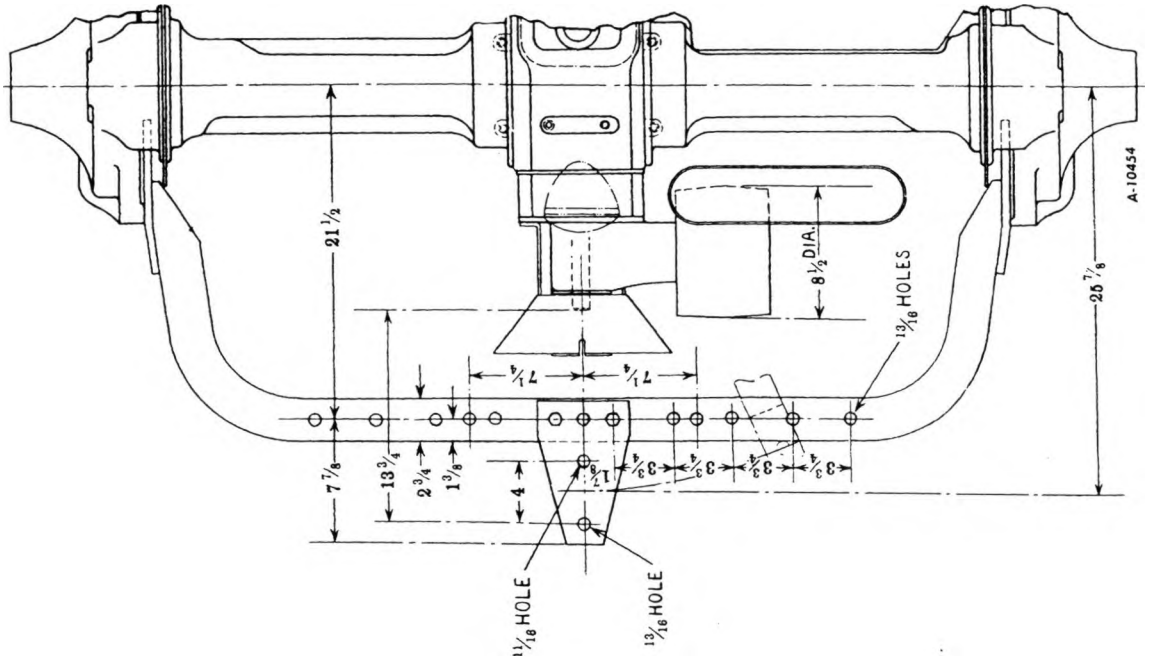


Illust. 73. Farmall-AV drawbar dimensions.

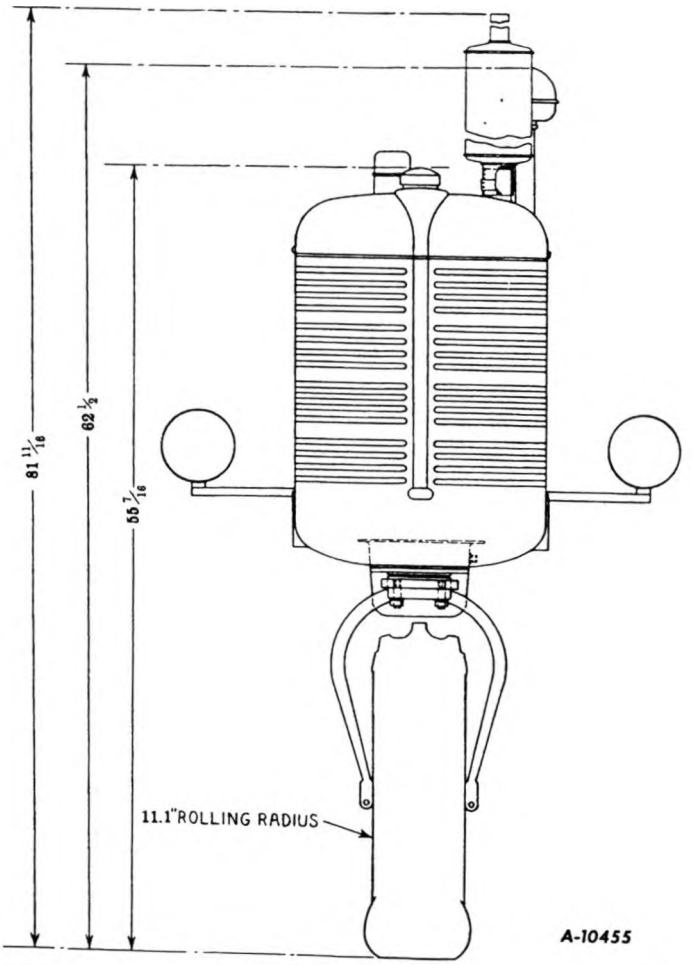
DIMENSIONAL DRAWINGS



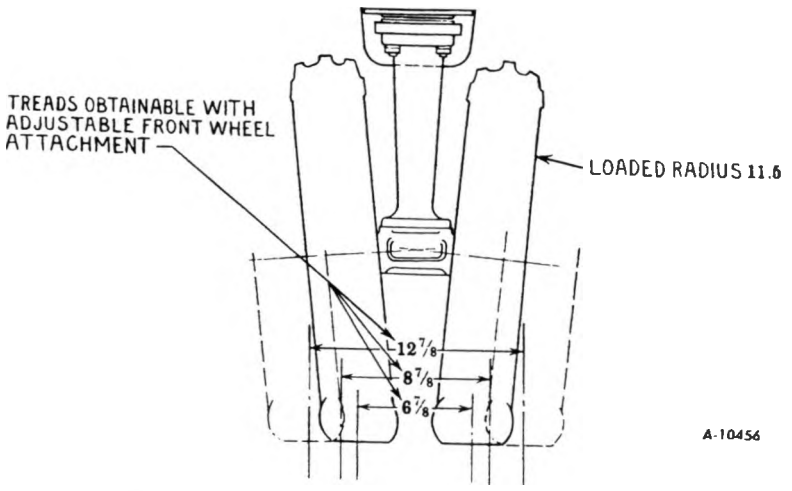
Illust. 74. Rear view of Farmall-B, showing dimensions.



Illust. 75. Farmall-B drawbar dimensions.

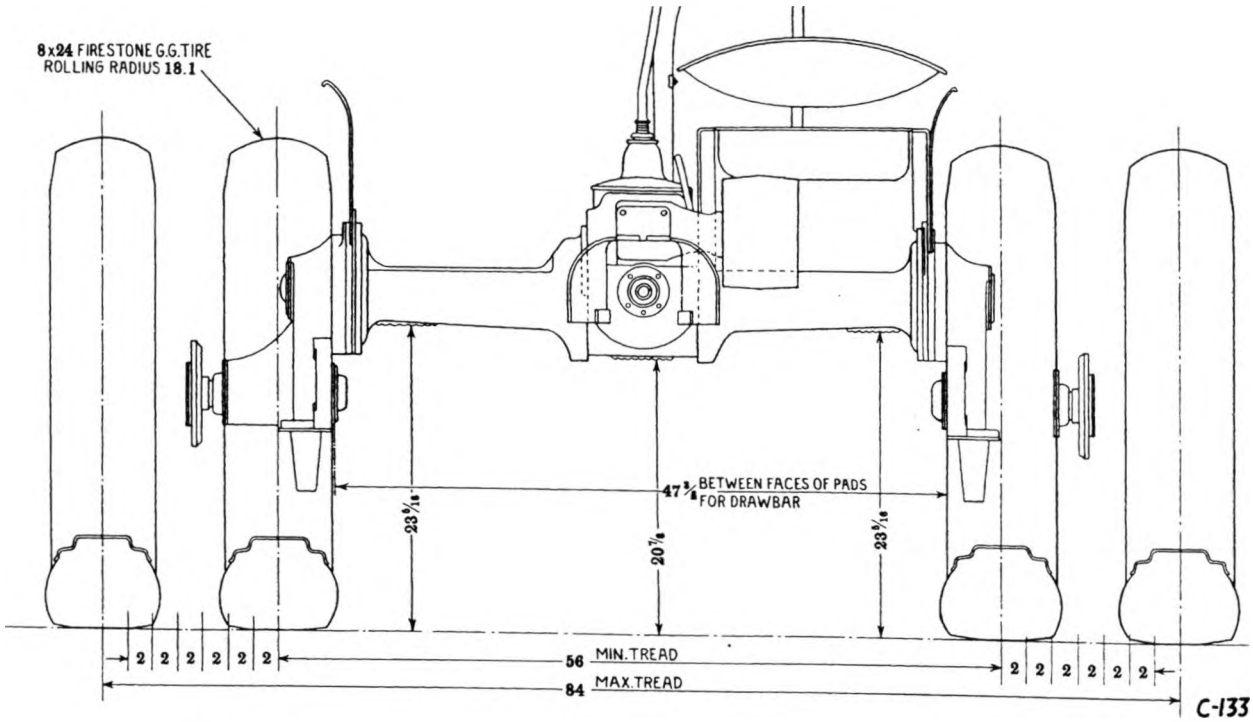


Illust. 76. Front view of Farmall-B, showing dimensions.

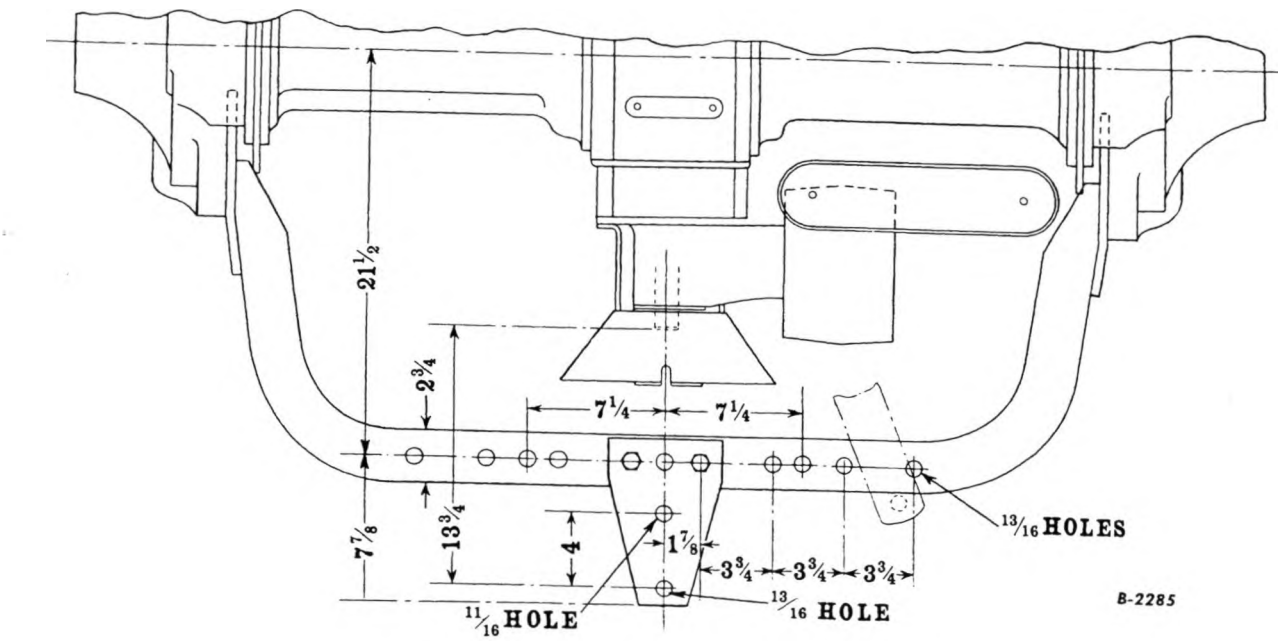


Illust. 77. Adjustable double front wheel attachment, showing dimensions.

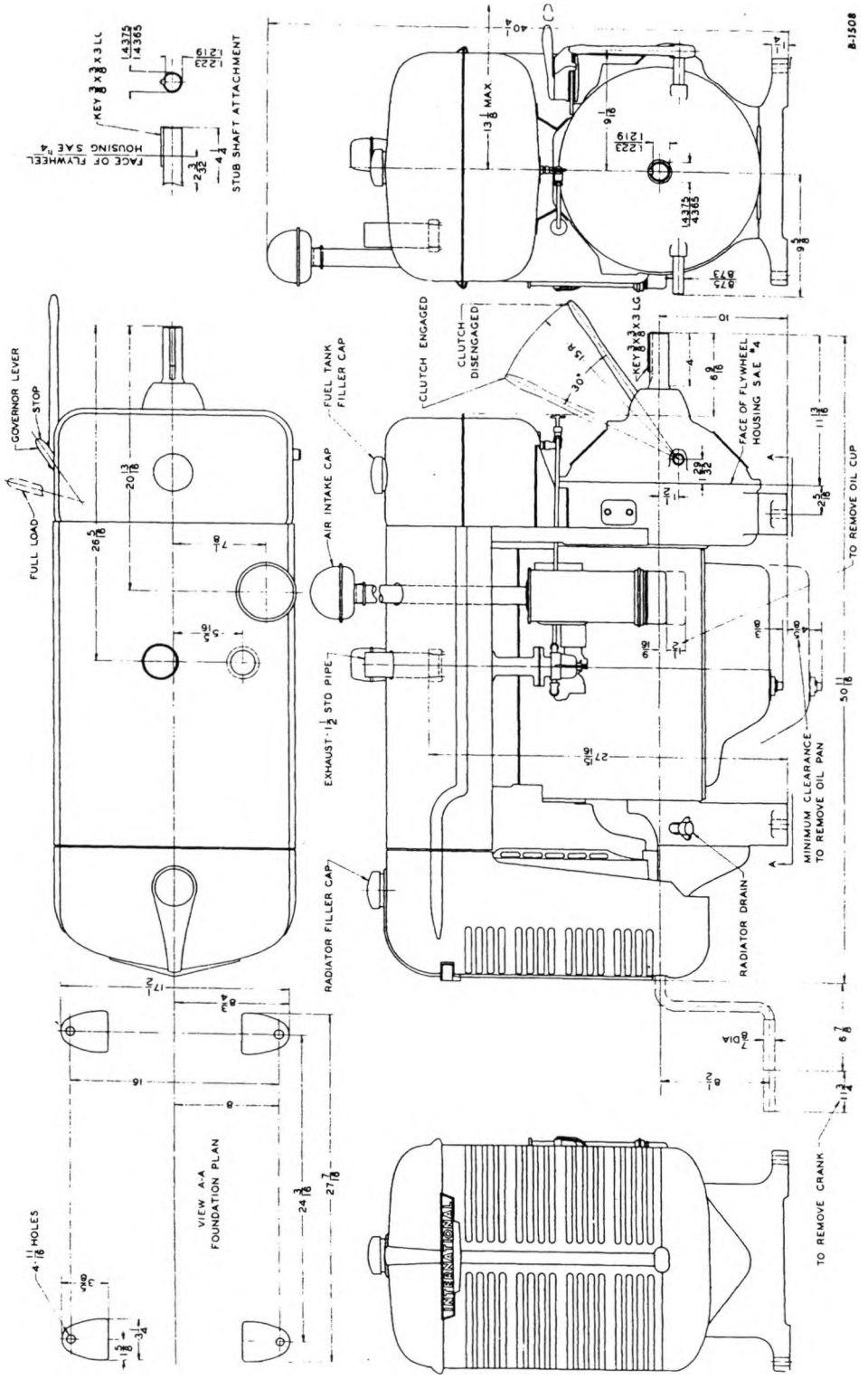
DIMENSIONAL DRAWINGS



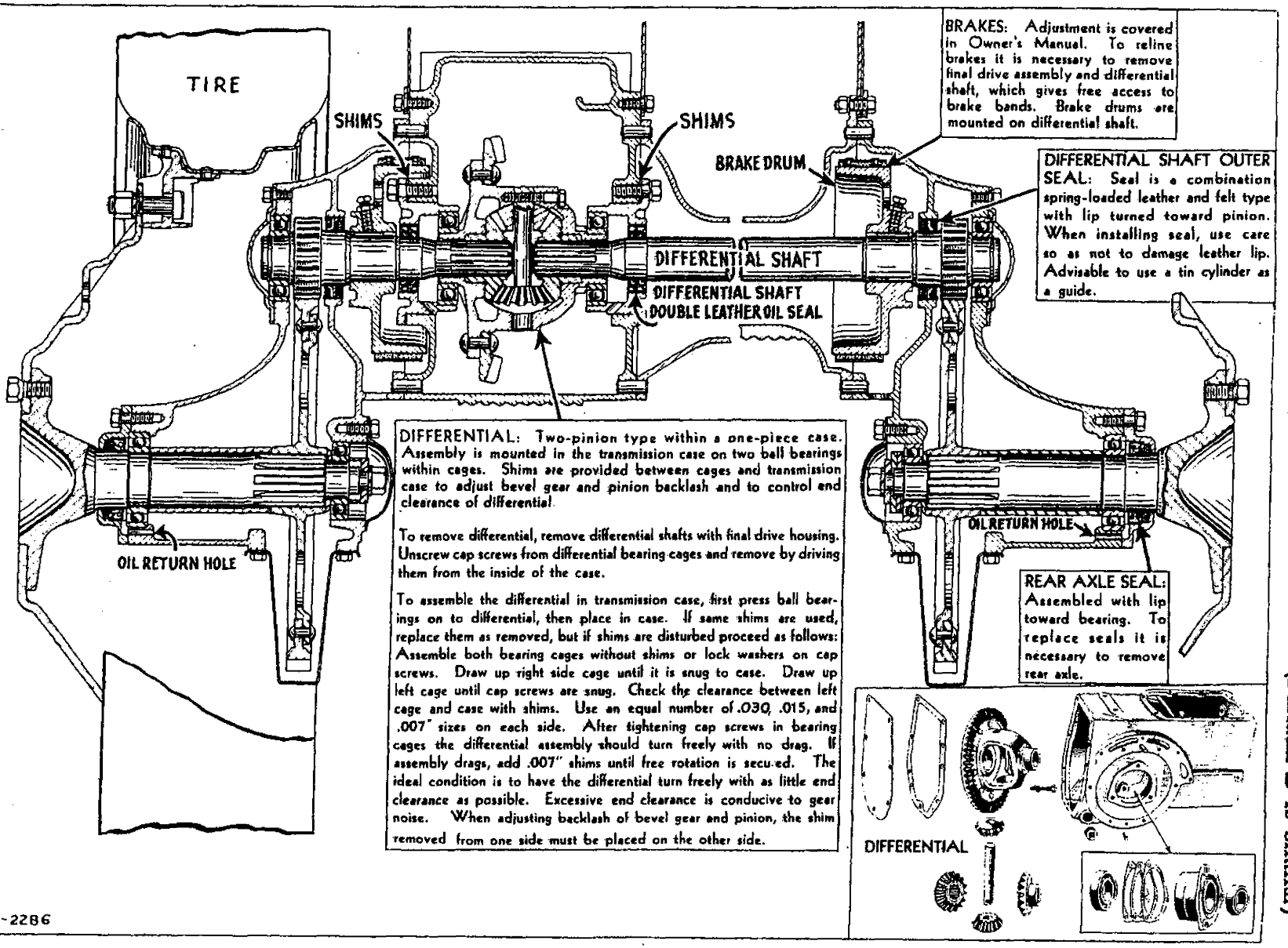
Illust. 78. Rear view of Farmall-BN, showing dimensions.



Illust. 79. Farmall-BN drawbar dimensions.



Illust. 80. U-2 power unit dimensional drawing.



BRAKES: Adjustment is covered in Owner's Manual. To reline brakes it is necessary to remove final drive assembly and differential shaft, which gives free access to brake bands. Brake drums are mounted on differential shaft.

DIFFERENTIAL SHAFT OUTER SEAL: Seal is a combination spring-loaded leather and felt type with lip turned toward pinion. When installing seal, use care so as not to damage leather lip. Advisable to use a tin cylinder as a guide.

DIFFERENTIAL: Two-pinion type within a one-piece case. Assembly is mounted in the transmission case on two ball bearings within cages. Shims are provided between cages and transmission case to adjust bevel gear and pinion backlash and to control end clearance of differential.

To remove differential, remove differential shafts with final drive housing. Unscrew cap screws from differential bearing cages and remove by driving them from the inside of the case.

To assemble the differential in transmission case, first press ball bearings on to differential, then place in case. If same shims are used, replace them as removed, but if shims are disturbed proceed as follows: Assemble both bearing cages without shims or lock washers on cap screws. Draw up right side cage until it is snug to case. Draw up left cage until cap screws are snug. Check the clearance between left cage and case with shims. Use an equal number of .030, .015, and .007" sizes on each side. After tightening cap screws in bearing cages the differential assembly should turn freely with no drag. If assembly drags, add .007" shims until free rotation is secured. The ideal condition is to have the differential turn freely with as little end clearance as possible. Excessive end clearance is conducive to gear noise. When adjusting backlash of bevel gear and pinion, the shim removed from one side must be placed on the other side.

REAR AXLE SEAL: Assembled with lip toward bearing. To replace seals it is necessary to remove rear axle.

DIFFERENTIAL

Chart 1. Cross Section Through Rear of Farmall-A (Farmall-B is similar)

Chart 2. Cross Section Through Right Side of Farmall-A (Farmall-B is similar)

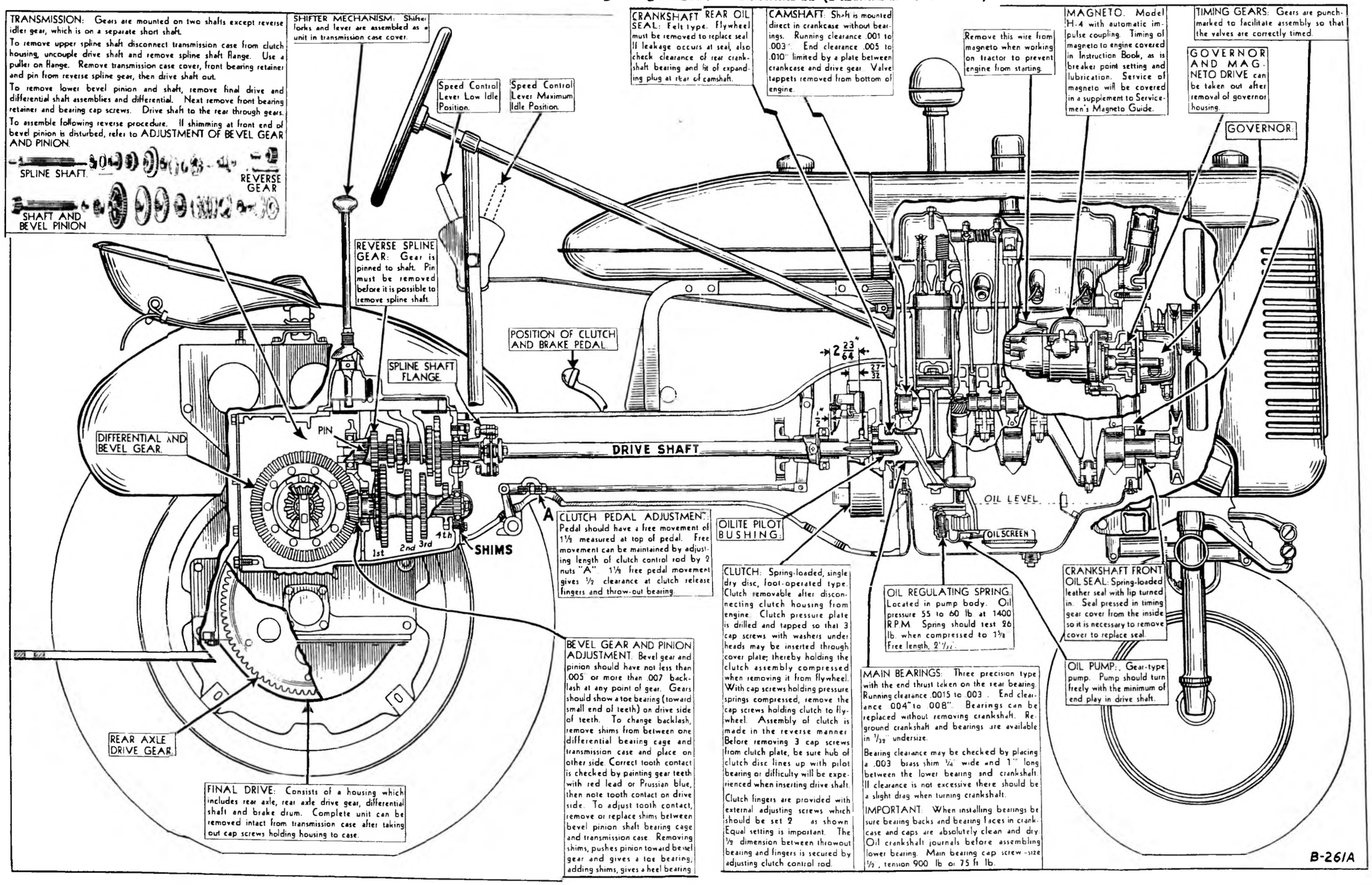
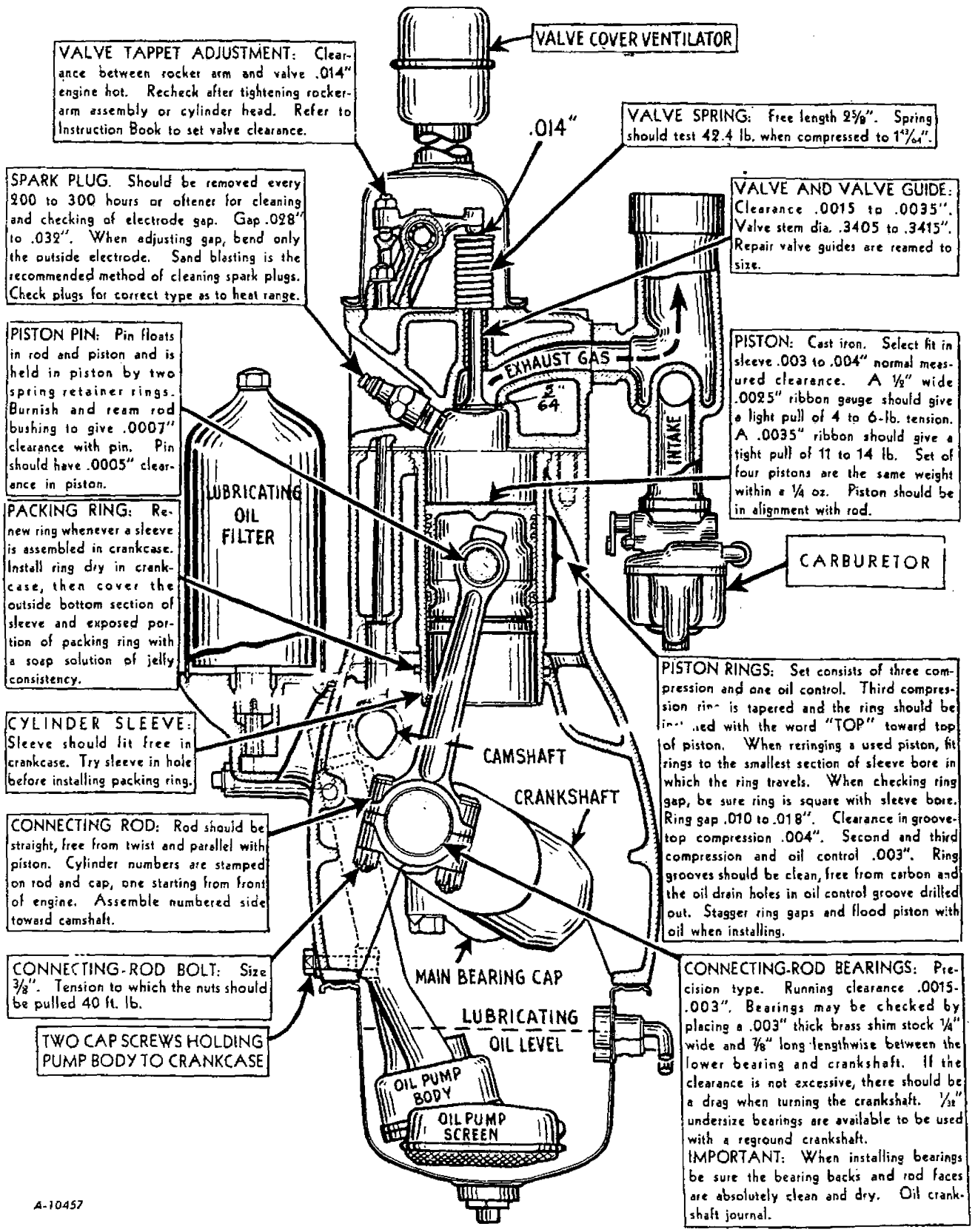

TRANSMISSION: Gears are mounted on two shafts except reverse idler gear, which is on a separate short shaft.
To remove upper spline shaft disconnect transmission case from clutch housing, uncouple drive shaft and remove spline shaft flange. Use a puller on flange. Remove transmission case cover, front bearing retainer and pin from reverse spline gear, then drive shaft out.
To remove lower bevel pinion and shaft, remove final drive and differential shaft assemblies and differential. Next remove front bearing retainer and bearing cap screws. Drive shaft to the rear through gears.
To assemble following reverse procedure. If shimming at front end of bevel pinion is disturbed, refer to ADJUSTMENT OF BEVEL GEAR AND PINION.
SPLINE SHAFT
REVERSE GEAR
SHAFT AND BEVEL PINION
SHIFTER MECHANISM: Shifter forks and lever are assembled as a unit in transmission case cover.
Speed Control Lever Low Idle Position.
Speed Control Lever Maximum Idle Position.
CRANKSHAFT REAR OIL SEAL: Felt type. Flywheel must be removed to replace seal. If leakage occurs at seal, also check clearance of rear crankshaft bearing and fit of expanding plug at rear of camshaft.
CAMSHAFT: Shaft is mounted direct in crankcase without bearings. Running clearance .001 to .003". End clearance .005 to .010" limited by a plate between crankcase and drive gear. Valve tappets removed from bottom of engine.
Remove this wire from magneto when working on tractor to prevent engine from starting.
MAGNETO. Model H-4 with automatic impulse coupling. Timing of magneto to engine covered in Instruction Book, as is breaker point setting and lubrication. Service of magneto will be covered in a supplement to Servicemen's Magneto Guide.
TIMING GEARS: Gears are punch-marked to facilitate assembly so that the valves are correctly timed.
GOVERNOR AND MAGNETO DRIVE can be taken out after removal of governor housing.
GOVERNOR
REVERSE SPLINE GEAR: Gear is pinned to shaft. Pin must be removed before it is possible to remove spline shaft.
POSITION OF CLUTCH AND BRAKE PEDAL
SPLINE SHAFT FLANGE
PIN
DRIVE SHAFT
DIFFERENTIAL AND BEVEL GEAR
1st 2nd 3rd 4th
SHIMS
A
CLUTCH PEDAL ADJUSTMENT: Pedal should have a free movement of 1½ measured at top of pedal. Free movement can be maintained by adjusting length of clutch control rod by 2 nuts "A". 1½ free pedal movement gives ½ clearance at clutch release fingers and throw-out bearing.
OILITE PILOT BUSHING
OIL LEVEL
OIL SCREEN
CLUTCH: Spring-loaded, single dry disc, foot-operated type. Clutch removable after disconnecting clutch housing from engine. Clutch pressure plate is drilled and tapped so that 3 cap screws with washers under heads may be inserted through cover plate; thereby holding the clutch assembly compressed when removing it from flywheel. With cap screws holding pressure springs compressed, remove the cap screws holding clutch to flywheel. Assembly of clutch is made in the reverse manner. Before removing 3 cap screws from clutch plate, be sure hub of clutch disc lines up with pilot bearing or difficulty will be experienced when inserting drive shaft.
Clutch fingers are provided with external adjusting screws which should be set 2 as shown. Equal setting is important. The ½ dimension between throwout bearing and fingers is secured by adjusting clutch control rod.
OIL REGULATING SPRING. Located in pump body. Oil pressure 55 to 60 lb at 1400 R.P.M. Spring should test 26 lb. when compressed to 1⅜ Free length, 2"
MAIN BEARINGS: Three precision type with the end thrust taken on the rear bearing. Running clearance .0015 to .003". End clearance .004" to .008". Bearings can be replaced without removing crankshaft. Reground crankshaft and bearings are available in undersize.
Bearing clearance may be checked by placing a .003 brass shim ¼" wide and 1" long between the lower bearing and crankshaft. If clearance is not excessive there should be a slight drag when turning crankshaft.
IMPORTANT: When installing bearings be sure bearing backs and bearing faces in crankcase and caps are absolutely clean and dry. Oil crankshaft journals before assembling lower bearing. Main bearing cap screw - size ½, tension 900 lb or 75 ft lb.
CRANKSHAFT FRONT OIL SEAL: Spring-loaded leather seal with lip turned in. Seal pressed in timing gear cover from the inside so it is necessary to remove cover to replace seal.
OIL PUMP: Gear-type pump. Pump should turn freely with the minimum of end play in drive shaft.
BEVEL GEAR AND PINION ADJUSTMENT. Bevel gear and pinion should have not less than .005 or more than .007 backlash at any point of gear. Gears should show a toe bearing (toward small end of teeth) on drive side of teeth. To change backlash, remove shims from between one differential bearing cage and transmission case and place on other side. Correct tooth contact is checked by painting gear teeth with red lead or Prussian blue, then note tooth contact on drive side. To adjust tooth contact, remove or replace shims between bevel pinion shaft bearing cage and transmission case. Removing shims, pushes pinion toward bevel gear and gives a toe bearing; adding shims, gives a heel bearing.
REAR AXLE DRIVE GEAR
FINAL DRIVE: Consists of a housing which includes rear axle, rear axle drive gear, differential shaft and brake drum. Complete unit can be removed intact from transmission case after taking out cap screws holding housing to case.
B-261A

Chart 3. Cross Section Through Front of Farmalls A and B and U-2 Engine



VALVE TAPPET ADJUSTMENT: Clearance between rocker arm and valve .014" engine hot. Recheck after tightening rocker-arm assembly or cylinder head. Refer to Instruction Book to set valve clearance.

VALVE SPRING: Free length 2 5/8". Spring should test 42.4 lb. when compressed to 1 43/64".

SPARK PLUG. Should be removed every 200 to 300 hours or oftener for cleaning and checking of electrode gap. Gap .028" to .032". When adjusting gap, bend only the outside electrode. Sand blasting is the recommended method of cleaning spark plugs. Check plugs for correct type as to heat range.

VALVE AND VALVE GUIDE: Clearance .0015 to .0035". Valve stem dia. .3405 to .3415". Repair valve guides are reamed to size.

PISTON PIN: Pin floats in rod and piston and is held in piston by two spring retainer rings. Burnish and ream rod bushing to give .0007" clearance with pin. Pin should have .0005" clearance in piston.

PISTON: Cast iron. Select fit in sleeve .003 to .004" normal measured clearance. A ½" wide .0025" ribbon gauge should give a light pull of 4 to 6-lb. tension. A .0035" ribbon should give a tight pull of 11 to 14 lb. Set of four pistons are the same weight within a ¼ oz. Piston should be in alignment with rod.

PACKING RING: Renew ring whenever a sleeve is assembled in crankcase. Install ring dry in crankcase, then cover the outside bottom section of sleeve and exposed portion of packing ring with a soap solution of jelly consistency.

CYLINDER SLEEVE: Sleeve should fit free in crankcase. Try sleeve in hole before installing packing ring.

PISTON RINGS: Set consists of three compression and one oil control. Third compression ring is tapered and the ring should be installed with the word "TOP" toward top of piston. When reringing a used piston, fit rings to the smallest section of sleeve bore in which the ring travels. When checking ring gap, be sure ring is square with sleeve bore. Ring gap .010 to .018". Clearance in groove-top compression .004". Second and third compression and oil control .003". Ring grooves should be clean, free from carbon and the oil drain holes in oil control groove drilled out. Stagger ring gaps and flood piston with oil when installing.

CONNECTING ROD: Rod should be straight, free from twist and parallel with piston. Cylinder numbers are stamped on rod and cap, one starting from front of engine. Assemble numbered side toward camshaft.

CONNECTING-ROD BOLT: Size 3/8". Tension to which the nuts should be pulled 40 ft. lb.

TWO CAP SCREWS HOLDING PUMP BODY TO CRANKCASE

CONNECTING-ROD BEARINGS: Precision type. Running clearance .0015-.003". Bearings may be checked by placing a .003" thick brass shim stock ¼" wide and 3/8" long lengthwise between the lower bearing and crankshaft. If the clearance is not excessive, there should be a drag when turning the crankshaft. 1/32" undersize bearings are available to be used with a reground crankshaft.
IMPORTANT: When installing bearings be sure the bearing backs and rod faces are absolutely clean and dry. Oil crankshaft journal.

A-10457

GENERAL SPECIFICATIONS

Models	A	AV	B	BN	Int. A	U-2
Approximate capacities (U.S. measure)						
Fuel tank, gallons	10	10	10	10	10	7
Starting fuel tank (when used), gallons	1	1	1	1	1	1
Water cooling system, gallons	3⅜	3⅜	3⅜	3⅜	3⅜	3⅜
Crankcase oil pan, quarts	5	5	5	5	5	5
Air cleaner oil cup, pints	¾	¾	¾	¾	¾	¾
Transmission and differential case, quarts	5	5	5	5	5	.....
Final drive gear case (each side), pints	3	3	3	3	3	.....
Power take-off or belt pulley (add to the transmission case), pints	1	1	1	1	1	.....
Steering gear case, quarts	1	1	1	1	1	.....
Engine						
Cylinders, number	4	4	4	4	4	4
Cylinders, type	wet sleeve	wet sleeve	wet sleeve	wet sleeve	wet sleeve	wet sleeve
Bore and stroke, inches	3 x 4	3 x 4	3 x 4	3 x 4	3 x 4	3 x 4
Governor speed under load, r.p.m.	900 to 1400	900 to 1400	900 to 1400	900 to 1400	900 to 1400	1000 to 180(
Magneto (fixed spark, clockwise rotation)	IH—H-4	IH—H-4	IH—H-4	IH—H-4	IH—H-4	IH—H-4
Spark plug size, mm,	18	18	18	18	18	18
Spark plug gap, inches	.028 to .032	.028 to .032	.028 to .032	.028 to .032	.028 to .032	.028 to .032
Valve clearance, engine hot, inches	.014	.014	.014	.014	.014	.014
Carburetor (up draft), inches	⅞	⅞	⅞	⅞	⅞	⅞
Clutch						
Type	spring-loaded	spring-loaded	spring-loaded	spring-loaded	spring-loaded	overcenter
Size, inches	9	9	9	9	9	9
Transmission speeds, m.p.h.						
Based on pneumatic tire size	8—24	8—36	8—24	8—24	8—24	.....
Speed in m.p.h. 1st	2¼	2⅞	2¼	2¼	2¼	.....
Speed in m.p.h. 2nd	3½	4⅝	3½	3½	3½	.....
Speed in m.p.h. 3rd	4⅝	6⅛	4⅝	4⅝	4⅝	.....
Speed in m.p.h. 4th	9⅝	12¾	9⅝	9⅝	9⅝	.....
Speed in m.p.h. Reverse	2¾	3⅝	2¾	2¾	2¾	.....
Belt pulley attachment (special)						
Pulley speed, max. full load, r.p.m.	1157	1157	1157	1157	1157	1800
Belt speed (8½ inch pulley), feet per min.	2574	2574	2574	2574	2574	4006
Power take-off attachment (special)						
Shaft speed (max. full load), r.p.m.	541	541	541	541	541	.....
Spline diameter (std. hitch), inches	1⅜	1⅜	1⅜	1⅜	1⅜	.....
Wheels and treads						
Front wheels toe-in, inches	⅛ to ¼	⅛ to ¼	single wheel	single wheel	⅛ to ¼	.....
Front wheel tread, inches	43	44 to 68	single wheel	single wheel	44 to 64	.....
Front tire (regular), size	4.00 x 15	4.00 x 19	6.00 x 12	6.00 x 12	4.00 x 15	.....
Rear tires (regular), size	8—24	8—36	8—24	8—24	8—24	.....
Rear wheel tread, inches	40 to 68	48 to 68	64 to 92	56 to 84	40 to 68	.....
Wheel base, inches	71	71	72½	72½	71	.....
Brakes (foot operated)						
External, contracting on drums	X	X	X	X	X	.....
Drawbar (flat bar type)						
Vertical adjustment from ground level, inches	10⅜ to 16½	11⅞ to 17¾	10 to 16⅛	10 to 16⅛	12 to 17 11/16	.....
Lateral hitch positions each side of center, inches	9½	9½	17⅛	13⅛	9½	.....
Swinging drawbar attachment, available.	X	X	X	X	X	.....